CMP CULVERTS SIZING

UNIFORM FLOW IN CIRCULAR CONDUITS

HORROCKS ENGINEERS

CO-OP Mine - CMP Culverts

PROJECT No. : 8309-42 DATE : April 30, 1984

SUMMARY OF UNIFORM FLOW CALCULATIONS
CIRCULAR CONDUITS

*** 0=UNKNOWN ---- 1=KNOWN ***

VELOCITY	DISCHARGE	DEPTH	MANNING	SLOPE	DIAMETER
0	0	1	1	1	1

COMPUTED DATA :

VELOCITY (fps)	DISCHARGE (cfs)	DEPTH (inches)	MANNING	SLOPE	DIAMETER (inches)
9.50	16.793	18.00	0.02300	0.08000	18.0

FROUDE NUMBER	REYNOLDS NUMBER	CRITICAL DEPTH (inches)	CRITICAL SLOPE	CRITICAL DISCHARGE (cfs)
0.09	329962	0.00	0.00000	0.000

FOR THE ABOVE LISTED CONDITIONS, THE FLOW IS SUBCRITICAL TURBULENT

C-1R 10,2 cfs required
C-2R 12,1 cfs required
C-3R 10,4 cfs required

UNIFORM FLOW IN CIRCULAR CONDUITS

HORROCKS ENGINEERS

CO-OP Mine - CMP Culverts

PROJECT No. : 8309-42

DATE : April 30, 1984

SUMMARY OF UNIFORM FLOW CALCULATIONS
CIRCULAR CONDUITS

*** 0=UNKNOWN ---- 1=KNOWN ***

VELOCITY	DISCHARGE	DEPTH	MANNING	SLOPE	DIAMETER
0	0	1	1	1	1

COMPUTED DATA :

VELOCITY (fps)	DISCHARGE (cfs)	DEPTH (inches)	MANNING	SLOPE	DIAMETER (inches)
12.32	10.722	7.00	0.02300	0.15000	30.0

FROUDE NUMBER	REYNOLDS NUMBER	CRITICAL DEPTH (inches)	CRITICAL SLOPE	CRITICAL DISCHARGE (cfs)
3.38	393847	13.20	0.01335	35.939

FOR THE ABOVE LISTED CONDITIONS, THE FLOW IS SUPERCRITICAL TURBULENT

C-10 8.8 cfs required

UNIFORM FLOW IN CIRCULAR CONDUITS

HORROCKS ENGINEERS

CO-OP Mine - CMP Culverts

PROJECT No. : 8309-42 DATE : April 30, 1984

SUMMARY OF UNIFORM FLOW CALCULATIONS
CIRCULAR CONDUITS

*** 0=UNKNOWN ----- 1=KNOWN ***

VELOCITY	DISCHARGE	DEPTH	MANNING	SLOPE	DIAMETER
0	0	1	1	1	1

COMPUTED DATA :

VELOCITY (fps)	DISCHARGE (cfs)	DEPTH (inches)	MANNING	SLOPE	DIAMETER (inches)
8.38	2.200	4.00	0.02300	0.15000	15.0

FROUDE NUMBER	REYNOLDS NUMBER	CRITICAL DEPTH (inches)	CRITICAL SLOPE	CRITICAL DISCHARGE (cfs)
3.03	150185	7.13	0.01732	6.475

FOR THE ABOVE LISTED CONDITIONS, THE FLOW IS SUPERCRITICAL TURBULENT

C-2U 1.5 cfs required

UNIFORM FLOW IN CIRCULAR CONDUITS

HORROCKS ENGINEERS

CO-OP Mine - CMP Culverts

PROJECT No. : 8309-42 DATE : April 30, 1984

SUMMARY OF UNIFORM FLOW CALCULATIONS
CIRCULAR CONDUITS

*** 0=UNKNOWN ----- 1=KNOWN ***

VELOCITY	DISCHARGE	DEPTH	MANNING	SLOPE	DIAMETER
0	0	1	1	1	1

COMPUTED DATA :

VELOCITY (fps)	DISCHARGE (cfs)	DEPTH (inches)	MANNING	SLOPE	DIAMETER (inches)
5.73	4.503	12.00	0.02300	0.05000	12.0

FROUDE NUMBER	REYNOLDS NUMBER	CRITICAL DEPTH (inches)	CRITICAL SLOPE	CRITICAL DISCHARGE (cfs)
0.06	132715	7.13	0.01732	6.475

FOR THE ABOVE LISTED CONDITIONS, THE FLOW IS SUBCRITICAL TURBULENT

C 3 U 7,9 cfs required

- 4,5

3,4 cfs Flows in ditch to next culvert

UNIFORM FLOW IN CIRCULAR CONDUITS

HORROCKS ENGINEERS

CO-OP Mine - CMP Culverts

PROJECT No. : 8309-42 DATE : April 30, 1984

SUMMARY OF UNIFORM FLOW CALCULATIONS
CIRCULAR CONDUITS

*** 0=UNKNOWN ----- 1=KNOWN ***

VELOCITY	DISCHARGE	DEPTH	MANNING	SLOPE	DIAMETER
0	0	1	1	1	1

COMPUTED DATA :

VELOCITY (fps)	DISCHARGE (cfs)	DEPTH (inches)	MANNING	SLOPE	DIAMETER (inches)
5.13	2.797	10.00	0.02300	0.05100	10.0

FROUDE NUMBER	REYNOLDS NUMBER	CRITICAL DEPTH (inches)	CRITICAL SLOPE	CRITICAL DISCHARGE (cfs)
0.06	98912	7.13	0.01732	6.475

FOR THE ABOVE LISTED CONDITIONS, THE FLOW IS SUBCRITICAL TURBULENT

C-40 6.1 cfs required

- 2.8

3.3 cfs Flows in ditch to next culvert

UNIFORM FLOW IN CIRCULAR CONDUITS

HORROCKS ENGINEERS

CO-OP Mine - CMP Culverts

PROJECT No. : 8309-42 DATE : April 30, 1984

SUMMARY OF UNIFORM FLOW CALCULATIONS
CIRCULAR CONDUITS

*** 0=UNKNOWN ----- 1=KNOWN ***

VELOCITY	DISCHARGE	DEPTH	MANNING	SLOPE	DIAMETER
0	0	1	1	1	1

COMPUTED DATA :

VELOCITY (fps)	DISCHARGE (cfs)	DEPTH (inches)	MANNING	SLOPE	DIAMETER (inches)
4.97	2.713	10.00	0.02300	0.04800	10.0

FROUDE NUMBER	REYNOLDS NUMBER	CRITICAL DEPTH (inches)	CRITICAL SLOPE	CRITICAL DISCHARGE (cfs)
0.06	95959	7.13	0.01732	6.475

FOR THE ABOVE LISTED CONDITIONS, THE FLOW IS SUBCRITICAL TURBULENT

C-5U 6.1 cfs required

-2.7

3.4 cfs flows in ditch to next culvert

UNIFORM FLOW IN CIRCULAR CONDUITS

HORROCKS ENGINEERS

CO-OP Mine - CMP Culverts

PROJECT No. : 8309-42 DATE : April 30, 1984

SUMMARY OF UNIFORM FLOW CALCULATIONS
CIRCULAR CONDUITS

*** 0=UNKNOWN ---- 1=KNOWN ***

VELOCITY	DISCHARGE	DEPTH	MANNING	SLOPE	DIAMETER
0	0	1	1	1	1

COMPUTED DATA :

VELOCITY (fps)	DISCHARGE (cfs)	DEPTH (inches)	MANNING	SLOPE	DIAMETER (inches)
4.37	2.382	10.00	0.02300	0.03700	10.0

FROUDE NUMBER	REYNOLDS NUMBER	CRITICAL DEPTH (inches)	CRITICAL SLOPE	CRITICAL DISCHARGE (cfs)
0.05	84249	7.13	0.01732	6.475

FOR THE ABOVE LISTED CONDITIONS, THE FLOW IS SUBCRITICAL TURBULENT

C-60 0,9 cfs required

UNIFORM FLOW IN CIRCULAR CONDUITS

HORROCKS ENGINEERS

CO-OP Mine - CMP Culverts

PROJECT No. : 8309-42 DATE : April 30, 1984

SUMMARY OF UNIFORM FLOW CALCULATIONS
CIRCULAR CONDUITS

*** 0=UNKNOWN ----- 1=KNOWN ***

VELOCITY	DISCHARGE	DEPTH	MANNING	SLOPE	DIAMETER
0	0	1	1	1	1

COMPUTED DATA :

VELOCITY (fps)	DISCHARGE (cfs)	DEPTH (inches)	MANNING	SLOPE	DIAMETER (inches)
9.68	17.105	18.00	0.02300	0.08300	18.0

FROUDE NUMBER	REYNOLDS NUMBER	CRITICAL DEPTH (inches)	CRITICAL SLOPE	CRITICAL DISCHARGE (cfs)
0.09	336092	7.13	0.01732	6.475

FOR THE ABOVE LISTED CONDITIONS, THE FLOW IS SUBCRITICAL TURBULENT

C-70 10.3 cfs required

UNIFORM FLOW IN CIRCULAR CONDUITS

HORROCKS ENGINEERS

CO-OP Mine - CMP Culverts

PROJECT No. : 8309-42 DATE : April 30, 1984

SUMMARY OF UNIFORM FLOW CALCULATIONS
CIRCULAR CONDUITS

*** 0=UNKNOWN ---- 1=KNOWN ***

VELOCITY	DISCHARGE	DEPTH	MANNING	SLOPE	DIAMETER
0	0	1	1	1	1

COMPUTED DATA :

VELOCITY (fps)	DISCHARGE (cfs)	DEPTH (inches)	MANNING	SLOPE	DIAMETER (inches)
13.01	22.995	18.00	0.02300	0.15000	18.0

FROUDE NUMBER	REYNOLDS NUMBER	CRITICAL DEPTH (inches)	CRITICAL SLOPE	CRITICAL DISCHARGE (cfs)
0.12	451819	15.48	0.03473	23.894

FOR THE ABOVE LISTED CONDITIONS, THE FLOW IS SUBCRITICAL TURBULENT

C-80 8.8 cfs required

UNIFORM FLOW IN CIRCULAR CONDUITS

HORROCKS ENGINEERS

CO-OP Mine - CMP Culverts

PROJECT No. : 8309-42 DATE : April 30, 1984

SUMMARY OF UNIFORM FLOW CALCULATIONS
CIRCULAR CONDUITS

*** 0=UNKNOWN ----- 1=KNOWN ***

VELOCITY	DISCHARGE	DEPTH	MANNING	SLOPE	DIAMETER
0	0	1	1	1	1

COMPUTED DATA :

VELOCITY (fps)	DISCHARGE (cfs)	DEPTH (inches)	MANNING	SLOPE	DIAMETER (inches)
8.04	9.865	15.00	0.02300	0.07300	15.0

FROUDE NUMBER	REYNOLDS NUMBER	CRITICAL DEPTH (inches)	CRITICAL SLOPE	CRITICAL DISCHARGE (cfs)
0.08	232601	15.48	0.03473	23.894

FOR THE ABOVE LISTED CONDITIONS, THE FLOW IS SUBCRITICAL TURBULENT

C-90 1,5 cfs Req'd

UNIFORM FLOW IN CIRCULAR CONDUITS

HORROCKS ENGINEERS

CO-OP Mine - CMP Culverts

PROJECT No. : 8309-42 DATE : April 30, 1984

SUMMARY OF UNIFORM FLOW CALCULATIONS
CIRCULAR CONDUITS

*** 0=UNKNOWN ----- 1=KNOWN ***

VELOCITY	DISCHARGE	DEPTH	MANNING	SLOPE	DIAMETER
0	0	1	1	1	1

COMPUTED DATA :

VELOCITY (fps)	DISCHARGE (cfs)	DEPTH (inches)	MANNING	SLOPE	DIAMETER (inches)
10.93	3.914	5.00	0.02300	0.20000	15.0

FROUDE NUMBER	REYNOLDS NUMBER	CRITICAL DEPTH (inches)	CRITICAL SLOPE	CRITICAL DISCHARGE (cfs)
3.49	235557	9.60	0.02101	12.079

FOR THE ABOVE LISTED CONDITIONS, THE FLOW IS SUPERCRITICAL TURBULENT

C-1D 1.5 cfs required

UNIFORM FLOW IN CIRCULAR CONDUITS

HORROCKS ENGINEERS

CO-OP Mine - CMP Culverts

PROJECT No. : 8309-42 DATE : April 30, 1984

SUMMARY OF UNIFORM FLOW CALCULATIONS
CIRCULAR CONDUITS

*** 0=UNKNOWN ---- 1=KNOWN ***

VELOCITY	DISCHARGE	DEPTH	MANNING	SLOPE	DIAMETER
0	0	1	1	1	1

COMPUTED DATA :

VELOCITY (fps)	DISCHARGE (cfs)	DEPTH (inches)	MANNING	SLOPE	DIAMETER (inches)
9.56	4.931	6.00	0.02300	0.12000	18.0

FROUDE NUMBER	REYNOLDS NUMBER	CRITICAL DEPTH (inches)	CRITICAL SLOPE	CRITICAL DISCHARGE (cfs)
2.79	247253	10.26	0.01793	12.756

FOR THE ABOVE LISTED CONDITIONS, THE FLOW IS SUPERCRITICAL TURBULENT

C-2D 4.8 cfs required

UNIFORM FLOW IN CIRCULAR CONDUITS

HORROCKS ENGINEERS

CO-OP Mine - CMP Culverts

PROJECT No. : 8309-42

DATE : April 30, 1984

SUMMARY OF UNIFORM FLOW CALCULATIONS
CIRCULAR CONDUITS

*** 0=UNKNOWN ----- 1=KNOWN ***

VELOCITY	DISCHARGE	DEPTH	MANNING	SLOPE	DIAMETER
0	0	1	1	1	1

COMPUTED DATA :

VELOCITY (fps)	DISCHARGE (cfs)	DEPTH (inches)	MANNING	SLOPE	DIAMETER (inches)
5.25	4.127	12.00	0.02300	0.04200	12.0

FROUDE NUMBER	REYNOLDS NUMBER	CRITICAL DEPTH (inches)	CRITICAL SLOPE	CRITICAL DISCHARGE (cfs)
0.06	121635	10.26	0.01793	12.756

FOR THE ABOVE LISTED CONDITIONS, THE FLOW IS SUBCRITICAL TURBULENT

C-3D 1,2 cfs required

UNIFORM FLOW IN CIRCULAR CONDUITS

HORROCKS ENGINEERS

CO-OP Mine - CMP Culverts

PROJECT No. : 8309-42 DATE : April 30, 1984

SUMMARY OF UNIFORM FLOW CALCULATIONS
CIRCULAR CONDUITS

*** 0=UNKNOWN ---- 1=KNOWN ***

VELOCITY	DISCHARGE	DEPTH	MANNING	SLOPE	DIAMETER
0	0	1	1	1	1

COMPUTED DATA :

VELOCITY (fps)	DISCHARGE (cfs)	DEPTH (inches)	MANNING	SLOPE	DIAMETER (inches)
13.82	271.436	60.00	0.02300	0.03400	60.0

FROUDE NUMBER	REYNOLDS NUMBER	CRITICAL DEPTH (inches)	CRITICAL SLOPE	CRITICAL DISCHARGE (cfs)
0.07	1600012	10.26	0.01793	12.756

FOR THE ABOVE LISTED CONDITIONS, THE FLOW IS SUBCRITICAL TURBULENT

60" CMP 231.2 cfs required

CMP CULVERTS

Headwater Depths

HORROCKS/CAROLLO ENGINEERS
AMERICAN FORK, UTAH
April 25, 1984

ORIFICE

ORIFICE = 10.00 INCHES

ELEV. (FT.)	FLOW (CFS)
0.00	0.00
0.25	0.31
0.50	0.88
0.75	1.62
1.00	2.01
1.25	2.40
1.50	2.73
1.75	3.03
2.00	3.30
2.25	3.56
2.50	3.79
2.75	4.01
3.00	4.22

FORMULA USED Q = C * A * SQR 2gh HEAD > Dia

Q = 3 * D * HEAD^1.5 HEAD < Dia

C = 0,60

D = 10 inches

HORROCKS/CAROLLO ENGINEERS
AMERICAN FORK, UTAH
April 25, 1984

ORIFICE

ORIFICE = 12.00 INCHES

ELEV. (FT.)	FLOW (CFS)
0.00	0.00
0.25	0.38
0.50	1.06
0.75	1.95
1.00	2.67
1.25	3.28
1.50	3.78
1.75	4.23
2.00	4.63
2.25	5.00
2.50	5.35
2.75	5.67
3.00	5.98

FORMULA USED Q = C * A * SQR 2gh HEAD > Dia

Q = 3 * D * HEAD^1.5 HEAD < Dia

C = 0.60

D = 12 inches

HORROCKS/CAROLLO ENGINEERS
AMERICAN FORK, UTAH
April 25, 1984

ORIFICE

ORIFICE = 15.00 INCHES

ELEV. (FT.)	FLOW (CFS)
0.00	0.00
0.25	0.47
0.50	1.33
0.75	2.44
1.00	3.75
1.25	4.67
1.50	5.53
1.75	6.27
2.00	6.93
2.25	7.53
2.50	8.09
2.75	8.61
3.00	9.11
3.25	9.57
3.50	10.02
3.75	10.45
4.00	10.86

FORMULA USED Q = C * A * SQR 2gh HEAD > Dia

Q = 3 * D * HEAD^1.5 HEAD < Dia

C = 0.60

D = 15 inches

HORROCKS/CAROLLO ENGINEERS
AMERICAN FORK, UTAH
April 25, 1984

ORIFICE

ORIFICE = 18.00 INCHES

ELEV. (FT.)	FLOW (CFS)
0.00	0.00
0.25	0.56
0.50	1.59
0.75	2.92
1.00	4.50
1.25	6.29
1.50	7.37
1.75	8.51
2.00	9.51
2.25	10.42
2.50	11.26
2.75	12.03
3.00	12.76
3.25	13.45
3.50	14.11
3.75	14.74
4.00	15.34
4.25	15.92
4.50	16.48

FORMULA USED Q = C * A * SQR 2gh HEAD > Dia

Q = 3 * D * HEAD^1.5 HEAD < Dia

C = 0.60

D = 18 inches

HORROCKS/CAROLLO ENGINEERS
AMERICAN FORK, UTAH
April 25, 1984

ORIFICE

ORIFICE = 24.00 INCHES

ELEV. (FT.)	FLOW (CFS)
0.00	0.00
0.50	2.12
1.00	6.00
1.50	11.02
2.00	15.13
2.50	18.53
3.00	21.39
3.50	23.92
4.00	26.20
4.50	28.30
5.00	30.25
5.50	32.09
6.00	33.82

FORMULA USED Q = C * A * SQR 2gh HEAD > Dia

Q = 3 * D * HEAD^1.5 HEAD < Dia

C = 0.60

D = 24 inches

HORROCKS/CAROLLO ENGINEERS
AMERICAN FORK, UTAH
April 25, 1984

ORIFICE

ORIFICE = 30.00 INCHES

ELEV. (FT.)	FLOW (CFS)
0.00	0.00
0.50	2.65
1.00	7.50
1.50	13.78
2.00	21.21
2.50	26.43
3.00	31.27
3.50	35.45
4.00	39.19
4.50	42.61
5.00	45.77
5.50	48.73
6.00	51.51

FORMULA USED Q = C * A * SQR 2gh HEAD > Dia

Q = 3 * D * HEAD^1.5 HEAD < Dia

C = 0.60

D = 30 inches

HORROCKS/CAROLLO ENGINEERS
AMERICAN FORK, UTAH
April 25, 1984

ORIFICE

ORIFICE = 60.00 INCHES

ELEV. (FT.)	FLOW (CFS)
0.00	0.00
0.50	5.30
1.00	15.00
1.50	27.56
2.00	42.43
2.50	59.29
3.00	77.94
3.50	98.22
4.00	120.00
4.50	143.19
5.00	149.48
5.50	163.75
6.00	176.87
6.50	189.08
7.00	200.55
7.50	211.40
8.00	221.72
8.50	231.58
9.00	241.04
9.50	250.13
10.00	258.91
10.50	267.40
11.00	275.63
11.50	283.63
12.00	291.40
12.50	298.97
13.00	306.35
13.50	313.56
14.00	320.61
14.50	327.50
15.00	334.26

FORMULA USED Q = C * A * SQR 2gh HEAD > Dia

Q = 3 * D * HEAD^1.5 HEAD < Dia

C = 0.60

D = 60 inches

APPENDIX 7- A

BEFORE THE BOARD OF OIL, GAS AND MINING

DEPARTMENT OF NATURAL RESOURCES

in and for the STATE OF UTAH

- - - - - - - - - - - - - - -

IN THE MATTER OF THE APPROVAL OF NOTICE OF INTENT AND RECLAMATION) PLAN SUBMITTED BY CO-OP MINING COMPANY.

CAUSE NO. ACT/015/025

- - - - -

BE IT REMEMBERED that on the 18th day of June, 1980, a hearing was held before the Board of Oil, Gas and Mining in the above-entitled matter and said hearing was taken before Athena Moore, a Certified Shorthand Reporter and Notary Public in and for the State of Utah, holding Utah C.S.R. License No. 88, commencing at the hour of 10:20 a.m. in the Wildlife Resources Auditorium, 1596 West North Temple, Salt Lake City, Utah.

Q Please give us your name and address and by whom you are employed?

A Bruce N. Kaliser, 2951 Nila Way, Salt Lake City. Employed by the State of Utah, Division of Utah Geological and Mineral Survey.

Q (By Mr. Feight) You have heard the testimony before the Board this morning and you have some comments to make relative to that and your own experience in the area?

A Yes. Briefly, my work consisted of examination of the literature, a field examination of the sites of the three springs; Bear Canyon, Little Bear Canyon, and Birch Spring in this vicinity in question.

Examination of the existing mine to which they will enter and expand and the geology in the vicinity of the field. This was done about a month ago at the request of Castle Valley Special Services District.

In brief, my conclusion is that it is highly unlikely that the mine plan as presented to me by the Co-op Company would interfere with the quantity or quality of any of those springs, particularly the one in question, the Bear Canyon

Spring.

Q What do you base this conclusion on?

A I base that on the hydrogeologic regime which I believe prevails in the vicinity. The source of the spring is the Star Point sandstones. There is a very predominant northeast striking joint and fault system that they parallel. The water contributory to this spring exists in my opinion to the north of the mine in the area of the Gentry Mountain. I believe that faults are a guiding, a strong guiding influence to the migratory pattern of groundwater regime in this area. But in entering the mine that Co-op will be going into, it appears that the faults evident in that mine underground are tight, and water is only a distant near the canyon walls. In other words, near the entry, near the portal, not further in. There is no evidence of any water further in.

I don't believe that at that locality there is precipitation recharging the aquifer, and so I am of the opinion that the mining operation will not affect the discharge of the spring.

Now I do have other data. I've looked at the data. I believe what's been presented here

this morning I have not been given copies of what you have. I don't know for a fact that I have seen everything in identical fashion that you have been presented. But it's probable the same data that I have been provided by the [illegible] district and the mine.

Q Mr. Kaliser, if you look at Protestant's Exhibit No. 2, could you kind of draw a fault line for the Board and tell them where you think the faults are to the mining operation, and from what I understand, you are saying that the faults are so tight in the area of the mine that there is no migration of water through the fault system, am I correct?

A At the elevation of the mine, the fault gauge is sufficiently tight, and the relief, the runoff that would occur in the vicinity of the mine, I don't believe you would get a contribution at that point. I'm not saying that the faults-- quite opposite--I'm not saying that the faults don't influence the groundwater pattern, but I'm saying that there is no evidence from what I see of the faults and in the mine that that is having any influence on the vertical migration of water down to the water table. There is no water table in

the mine.

Q Is the Star Point Formation [illegible] which is I understand is the water formation in [illegible] area, is above or below the coal seam?

A Below the coal seam. The coal seam is in the Blackhawk, so the mine is in the Blackhawk. I do believe there is hydraulic connection there between most of those formations because of that very prominent joint pattern that exists in this part of the plateau. And, of course, the area in this vicinity that we are speaking of is right in the present valley fault zone, so there are individual fault strands. Some of which are identified on existing geologic maps and some of which are in the field. In other words, identified faults not heretofore mapped and some showing presently on maps.

Q Approximately how many faults are there in the vicinity of the mine?

A In the vicinity of the mine I would say there could be three.

MR. BOX: Could you put those on the exhibit?

THE WITNESS: This map is sufficiently small in scale. I could, with a little time, but

I don't know if you want me to take up that time.

This is the larger scale.

MR. McINTYRE: Are they [illegible] northeast?

THE WITNESS: They are about [illegible] to Degrees East. They are about vertical in attitude.

MR. McINTYRE: And what about displacement?

THE WITNESS: Displacement, we've measured in the mine displacements of two and a half feet, four feet two inches and one foot three inches in each case down to the east toward the canyon and the strikes that we measured varied from North 8 East to North 11 East. They were all taken in the mine underground.

The greatest fault appears to be at about 600 feet west of the mine portal, the existing mine portal.

Now if that fault maintains its strike, it would not strike into the spring and examination of the immediate vicinity of the spring reveals no trace of the fault, interestingly enough it does show that the water is emerging from joints from this which are parallel to the fault, but that interestingly enough, no fault is [illegible] in the

immediate vicinity of the spring. You can see seepage being emitted from three distinct joints at the spring site. So it's quite an interesting situation.

I'm going to sketch on here some of the faults. I can do that, although the scale is such that you can't hold me to it. Birch Spring which is just around the corner, it's actually slightly northwest of Bear Canyon, but it is around the corner, cliffwise, and appears also to be emitted from a shear zone, a zone of closely spaced faults, but not distinct displacement. I can't observe any distinct fault displacements. It's an area that's highly deformed and has created this very prominent joint set, but you don't need displacement to create the channels, the secondary permeability roots.

MR. DANIELS: Can you hypothesize that this point produces the actual charge into the spring is from horizontal movement through the joint at or in the Star Point from areas to the north or to the west?

THE WITNESS: I think what happens to the north where principally the [illegible] on Gentry Mountain, there is a recharge [illegible] is

vertical down to the water table through the Blackhawk, and there is a recharge also from those channels which are from those drainages which are lying along the joint and the fault trend. That vertical migration then reaches the Star Point and travels laterally along shear zones, prominent joints or faults and emerges where the topography disects the formation. I think all this is happening well below the mine.

MR. DANIELS: Essentially what you're saying is the water is dropping down to the next formation below and falling in under the mine?

THE WITNESS: Right.

MR. McINTYRE: In your opinion is it highly probable that additional activity underground in the mine could actually increase the flow of water to the spring in question?

THE WITNESS: Depending upon the use of the water in the mine and how they go about mining. It's possible. I think it would have a negligible effect at this site. It might have a greater effect should they go up to the north.

MR. DANIELS: Have you got an opinion on subsidence of the mine whether actual subsidence of the roof of the mine would affect the water flow

to the spring?

A I don't believe that subsidence would have an effect, because I think the runoff over the slopes above the mine--the rule is the greater the slope is -- and it is to the north, and I don't think it would make a difference.

There was one or two locations within the mine where there was roof collapse. No water was observed, however.

MR. DANIELS: Thank you.

MR. CHAIRMAN: Bruce, are you through?

THE WITNESS: Yes.

APPENDIX 7-B

AGREEMENT

THIS AGREEMENT entered into this 27th day of January, 1982, by and between Co-op Mining Company, a Utah partnership, C.O.P., INC., a Utah corporation, hereinafter jointly referred to as "Co-op", and Huntington City, a municipal corporation, hereinafter called "City".

WITNESSETH:

THAT WHEREAS, Co-op is undertaking to develop and put into operation a coal mine in Big Bear Creek Canyon, in Emery County, Utah;

AND WHEREAS, City has received in the past and is now receiving a significant portion of its culinary water supply from a spring in Big Bear Creek Canyon in the general proximity of the proposed mining operation;

AND WHEREAS, the parties to this Agreement wish to cooperate with each other so as to assure that Co-op activities will not in any manner result in a loss or diminution of the water supply available to the City from the Spring, the parties do hereby AGREE and COVENANT between themselves as follows:

1. That, at the option of City, representatives of City and the Co-op will make inspections underground in the old Bear Canyon Mine and any other mine operated in Bear Canyon by Co-op, to check for water.

2. That the City will maintain a flow meter at the Spring site and shall take measurements from the meter on a continuing basis so that any interference with the water supply or diminution in the flow can be readily determined, and the flow figures as measured shall be made available to Co-op.

3. That in the event that the quality of water at the Big Bear Creek Spring site decreases below the standards set by the Utah State Board of Health for culinary water, or in the event that the quantity of water at the Big Bear Spring decreases in flow 25% below the flow for the month immediately preceding, in any 30-day period; or 50 per cent below the average flow for the preceding 180 days in any 180-day period and such decrease cannot reasonably be accounted for as being a result of a lack of precipitation or

Utah State Board of Health for culinary water. Co-op agrees to use all reasonable diligence to take the required action or make the required replacement of a permanent acceptable nature as rapidly as feasible, not to exceed one year, unless a greater time is required by law, and further agrees to maintain such temporary measures until permanent measures are completed, at Co-op's sole expense. In the event that water treatment is required to bring the water obtained by Co-op up to Utah State standards for culinary water, Co-op further agrees to pay the proportionate share of the cost for treatment of said water as long as the interruption continues. In the event it is later determined that such decrease in the flow or quality of water is not a result of Co-op's mining activities, City agrees to reimburse Co-op for its reasonable and necessary expenses incurred pursuant to this paragraph. Co-op further agrees that if said mining operations diminish or interfere with the flow of or quality of water from the above Spring to the extent that mechanical water treatment plant is necessary, said Co-op shall pay a percentage of the plant cost related to said plant, proportional to the water needing treatment as a result of the diminution in quality or quantity of the Big Bear Springs, compared to the total water being treated by the City.

4. The parties further agree that the figures of 25% and 50 per cent relative to a decrease in flow of the Big Bear Creek Spring cited in paragraph 3 above as the trigger for Co-op's obligation to replace said diminution of flow may be altered from time to time by mutual agreement of the parties after a period of three years, after which time the parities will have sufficient spring flow data to more accurately establish that point at which the diminution of flow at the Spring site is likely to have been caused by the Co-op's mining operations.

5. In the event that there is a good faith dispute between the parties hereto whether or not Co-op's mining activities are the cause of a diminished flow or quality in Big Bear Creek Spring, the parties shall cooperate in taking immediate corrective measures reasonably necessary to restore said flow or quality of water. Each party shall bear one-half of the cost thereof, provided that if it can [illegible] that said mining activities were not re-

able time for City's costs already paid pursuant to this Agreement.

6. In the event of good faith dispute between the parties as to the cause of any diminution in flow or quality of said Spring, the parties agree to appoint an arbitration committee and to be bound by the decision of said committee. This committee shall consist of five menbers: one Co-op representative, one City representative, and three representatives chosen by the other two members. The arbitration committee shall immediately meet and within 30 days make a preliminary decision as to the cause of any diminution in flow or quality of said Spring which preliminary decision shall bind the parties until the committee has had time to make a full investigation and reach a final decision. Nothing in this Agreement shall be construed as depriving either party of a right of action against any other non-parties including any insurance company issuing insurance pursuant to paragraph 9 hereof.

7. In the event any other mining operation or other activity of any other person or entity is proposed or planned in the area which may affect the flow of the Big Bear Creek Spring, City will require such person or entity to sign an agreement similar to this Agreement, binding such other person or entity to bear responsibility for any adverse effect such other person's or entity's activities may have upon the flow or quality of said Spring. In the event any diminution in the flow or quality of the Spring may be attributable to the activities of any person or entity other than Co-op, Co-op shall have the right to establish the same to City's reasonable satisfaction and thereby shall be entitled to reimbursement by City within a reasonable time from such establishment for reasonable costs incurred by Co-op for corrective action required under this Agreement to the extent it is established that such other person or entity is responsible for the diminished flow or quality. In that event City agrees to look to such other person or entity for such corrective action as it deems necessary.

8. This Agreement shall terminate and Co-op shall have no further obligation hereunder with respect to any diminution of flow of Big Bear Creek Spring, one year after the final termination of Co-op's or its successors in interests' mining

10. In the event legal action is brought to enforce the terms of this Agreement, the losing party in such action agrees to pay all costs thereof, including the reasonable attorney's fees of the prevailing party.

11. This Agreement shall cover the proposed mining operation on the Six Hundred Eighty (680) acres covered by and described in Cause No. ACT - 015-025, before the Utah Board of Oil, Gas and Mining, Department of Natural Resources.

12. As a condition to entering into the foregoing Agreement, the City agrees that it will withdraw its protest in Cause No. ACT - 015-025 before the Board of Oil, Gas and Mining, Department of Natural Resources of the State of Utah, and also it agrees that it will not protest the proposed mining operation on the the Six Hundred Eighty (680) acres as heretofore filed as a mining plan with the Board of Oil, Gas and Mining, Department of Natural Resources of the State of Utah, or protest the issuance by Emery County of any necessary building permits or approvals for Co-op's mining operations in Bear Canyon.

13. The City hereby specifically reserves its rights to protest any and all other legal remedies on all other mining plans or proposals on land not included in the acreage covered by this Agreement.

14. Co-op agrees that the transfer or assignment of the premises affecting said Spring or this Agreement shall not release Co-op from any obligations in this Agreement unless Huntington City has in writing consented to said release, which consent shall not be unreasonably withheld.

15. The parties shall not assign their obligations or rights under this Agreement without the mutual consent of each other.

16. It is agreed by the parties that this Agreement applies to and binds the heirs, executors, administrators, successors and assigns of the respective parties hereto.

IN WITNESS WHEREOF, the said parties to this Agreement have here unto affixed their signatures, the day and year first above written.

CO-OP MINING COMPANY

By _____

APPENDIX 7-C

INCORPORATED UNDER
THE LAWS OF THE STATE OF UTAH

NUMBER

SHARES

Huntington-Cleveland Irrigation Company

Capital $150,000 150,000 Shares

This Certifies That C. W. Kingston is the owner of

*****Three Hundred Thirty Three and 77/100***** Shares of the Capital Stock of

Huntington-Cleveland Irrigation Company

transferable only on the books of the Corporation by the holder hereof in person or by Attorney upon surrender of this Certificate properly endorsed.

IN WITNESS WHEREOF, the said Corporation has caused this Certificate to be signed by its duly authorized officers and its Corporate Seal to be hereunto affixed this 16 day of February A.D. 19 62

SECRETARY

PRESIDENT

SHARES $10 EACH

STATE OF UTAH
NATURAL RESOURCES
Water Rights

1636 West North Temple • Salt Lake City, UT 84116 • 801-533-6071

Scott M. Matheson, Governor
Temple A. Reynolds, Executive Director
Dee C. Hansen, State Engineer

November 8, 1983

Co-Op Mining Company
P. O. Box 1245
Huntington
Utah 84528

RE: Stream Alteration 570

Dear Applicant:

Application to Alter Natural Stream Number 570 has been approved pursuant to the requirements of Statute 73-3-29, Utah Code Annotated, 1953, subject to the following:

1. Installation of sediment control measures to prevent siltation of Huntington Creek prior to start of your project.

A copy of the **approved** application is being returned to you for your records.

Sincerely yours,

Donald C. Norseth
for Dee C. Hansen, P.E.
State Engineer

DCH.DCN.pmh

cc: M.P. Page, Price Area Office
Darrell Nish, Wildlife Resources

CHAPTER 8

SOILS

Chapter VIII

Soil Resources

Table of Contents

ents and Soil Amendments to be Used (817.25)

8.11 Mitigation and Control Plans

SCS Soil Survey_____Appendix 8-B

8.1 SCOPE

At the request of Wendell Owen, representing CO-OP Mining Company, and the San Rafael Soil Conservation District, the Soil Conservation Service performed a soil and vegetation survey on proposed mine property in Huntington Canyon. The surveys were designed to be comply with the March 1979 Permanent Regulatory Program Requirements to the Office of Surface Mining Reclamation and Enforcement, Department of Interior. (See Appendix 8-B SCS Report)

8.2 METHODOLOGY

The survey covers approximately 23 acres on Bear Creek in Huntington Canyon, Emery County, Section 25, T16S, R7E,SLBM. The soils are shown on the attached map. Each soil is identified with a three letter symbol, and the pattern and extent are shown by the soil boundary lines on the map. It should be noted that the entire survey area had been disturbed from previous mining activities. Therefore, the soil characteristics were projected from the surrounding areas. All areas having the same symbol are essentially the same kind of soils. There may be small areas of other soils included within the delineation that are slightly different. The soils are named but

have not been correlated. When the overall county survey is completed, small areas may become inclusions in other map units. Some names may change also. Included at the end of the report are the engineering uses and interpretations of the soils. The soil horizonation symbols, procedures, and nomenclature are as defined in the Soil Survey Manual (Ag. Handbook No. 18), National Soil Handbook of the Soil Conservation Service, and Soil Taxonomy.

SCS range conservationist, George Cook, visited each described soil in the survey area in November and recorded present vegetation and productivity according to ecological site analysis methods of the Soil Conservation Service. Present vegetation was recorded by percentage air dry weight. Estimates were made of annual production and range condition for the 1980 growing season. These findings are included in this report and the ecological sites identified on the soil map accompanying the soil report.

Most of the soils in the survey area are used as rangeland and wildlife habitat except where mine

disturbances have occurred. On areas that have similar climate and topography, the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between soils and vegetation and water. In this survey area the soils are grouped into ecological sites. An ecological site is an area or areas of rangeland or woodland uniform enough in climate, soils, drainage, exposures and topography that it supports a definite plant community that will produce a specific amount of vegetation. The kind of vegetation is generally the combination of plants that grew on the site before the range or woodland was affected by grazing, cultivation or otherwise altered and is called the potential vegetation. Normally the potential vegetation is the most productive combination of range or woodland plants that a site can support. Potential plant communities for the Bear Creek Canyon area obtained from clipping data, is not yet available from the Bureau of Land Management. As climate is a major factor in determining the potential plant community different climatic regime have been defined to facilitate the grouping of soils into ecological sites and the naming of sites. In this

survey area there are two climatic regimes used. These are defined generally as follows:

Upland Climatic Regime - The average annual precipitation is 12 to 16 inches. Approximately 35 to 40 percent comes during the summer months. The growing period usually begins about April 1 and lasts until the first of November until moisture is depleted or the plants mature. The freeze-free season is 100 to 130 days, and the mean annual temperature is 47° to 50° F.

Mountain Climatic Regime - The average annual precipitation is 12 to 16 inches. Approximately 35 percent comes during the summer months. The growing season begins in the later part of April and lasts until the middle of October or until moisture is depleted or the plants mature. The freeze-free season is 80 to 110 days and the mean annual temperature is 44° to 47° F.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is deter-

mined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site.

Such management generally results in the optimum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

More detailed information is available in the Price Field Office of the Soil Conservation Service.

8.3 SOIL INFORMATION

8.3.1 Soils Identification

SOIL LEGEND

SOIL SYMBOL	SOIL MAPPING UNIT NAME
D2E	Datino bouldery fine sandy loam, 5 to 20 percent slopes
DIG	Datino very stony fine sandy loam, 55 to 70 percent slopes

8.3.2 Soils Description

D2E Datino bouldery fine sandy loam, 5 to 20 percent slopes

This Datino soil is very deep and well drained. It occurs on moderately steep alluvial fans and some sloping flood plains at elevations of 7,100 to 7,140 feet (2,165 to 2,177 meters). This soil formed in alluvium and colluvium derived mainly from sandstone and shale. The average annual percipitation is 14 to 16 inches (36 to 41 centimeters). Mean annual air temperature

is 42 to 45 degrees F. (5 to 7 degrees C.), mean annual soil temperature is 44 to 47 degrees F. (6 to 8 degrees C.), and the average freeze-free season is about 80 to 110 days.

Slopes are 5 to 20 percent and mostly East facing. They are short and concave-convex.

Vegetation is dominantly pinyon, Utah juniper, salina wildrye, squirreltail, big sagebrush, Douglas-fir, and Rocky Mountain juniper.

Included in mapping are small areas of a similar soil except with 20 percent gravel and cobbles in the surface layer.

In a typical profile the surface layer is brown, bouldery fine sandy loam and cobbly loam about 10 inches (25 centimeters) thick. The subsoil is light brown very stony loam about 28 inches (71 centimeters) thick. The substratum is light reddish brown cobbly fine sandy loam to a depth of 60 inches (1.5 meters) or more.

Permeability is moderate. Available water capacity is 6 inches (15 centimeters) to a depth of 60 inches (1.5 meters). Organic matter content in the surface layer is 4 percent. Effective rooting depth is about 60 inches (1.5 meters). Surface runoff is medium and erosion hazard is moderate under potential native vegetation and high if vegetation is removed and the soil is left bare. Erodibility is low. This soil is used for range, wildlife habitat and mining operations.

Taxonomic classification is loamy-skeltal, mixed Typic Haploboralls.

A typical pedon of Datino bouldery fine sandy loam, 5 to 20 percent was described on the cut above 200 feet East and 1,100 feet South of the NW corner of Section 25, T16S, R7E.

All -- 0 to 2 inches (0 to 5 centimeters) brown (10YR 5/3) bouldery fine sandy loam, dark brown (10YR 3/3) when moist; moderate fine granular structure; loose, very friable, slightly sticky,

non-plastic; common very fine to medium, few coarse roots; 10 percent boulders, 10 percent stones, 5 percent cobbles, 10 percent gravel; slightly calcareous; moderately alkaline (8.0); abrupt smooth boundary.

A12 - - 2 to 10 inches (5 to 25 centimeters); brown (10 YR 5/3) cobbly loam, dark brown (10 YR 3/3 when moist; moderate medium granular structure; soft, friable, slightly sticky, slightly plastic; common very fine to medium, few coarse roots; 10 percent cobble and 10 percent gravel; moderately calcareous; moderately alkaline (ph 8.2); clear smooth boundary.

B2 - - 10 to 38 inches (25 to 96 centimeters); light brown 7.5YR 6/4) very stony loam, brown (7.5YR 4/4) when moist; weak medium subangular blocky structure; slightly hard, friable, slightly plastic; common very fine to medium roots; 1 percent boulders, 30 percent stone, 10 percent cobbles, 20 percent gravel; moderately calcareous; strongly alkaline (ph 8.5); abrupt wavy boundary.

C1 - - 38 to 60 inches (96 to 152 centimeters) light reddish brown (5YR 6/4) cobbly fine sandy loam, reddish brown (5YR 4/4) when moist; massive; soft, very friable, slightly sticky, non-plastic; few very fine and fine roots; 10 percent cobbles, 5 percent gravel; strongly calcareous; strongly alkaline (ph 8.6).

D1G Datino - Rock Outcrop Complex, 55 to 70 Percent Slopes

This map unit is on very steep canyon side-slopes. Slopes are short and concave-convex. Elevation is 7,140 to 7,600 feet (2,177 to 2,318 meters). The average annual precipitation is 14 to 16 inches (36 to 41 centimeters). Mean annual air temperature is 42 to 44 degrees F. (6 to 7 degree C.) and the average frost-freeze season is 80 to 110 degrees.

This unit is 75 percent Datino very stony fine sandy loam, 55 to 70 percent slopes in single and concave areas and 15 percent rock outcrop on ridges.

Included in this unit is about 6 to 15 inches in depth, associated with the rock outcrop.

The Datino soil is very deep and well drained. This soil formed in colluvium derived mainly from sandstone and shale. Slopes are 55 to 70 percent and East facing. They are short and concave-convex. Vegetation is dominantly pinyon, Utah juniper, Rocky Mountain juniper, salina wildrye, Douglas-fir, curlleaf mountain mahogany.

In a typical profile the surface layer is brown or yellowish brown, very stony fine sandy loam about 16 inches (41 centimeters) thick. The subsoil is very pale brown, very stony sandy clay loam about 20 inches (51 centimeters) thick. The substratum is very pale brown, very stony silty clay loam to a depth of more than 60 inches (152 centimeters).

Permeability is moderate to 36 inches (91 centimeters) and moderately slow below 36 inches. Available water capacity is 6.5 inches (16 centimeters) to a depth of 60 inches (1.5 meters). Organic matter content in the surface layer is

about 4 percent. Effective rooting depth is about 60 inches (1.5 meters). Surface runoff is rapid and erosion hazard is high under potential native vegetation and very high if vegetation is removed and the soil is left bare. Erodibility is low. This soil is used for range, wilflife habitat, and mining operation.

Taxonomic classification is loamy-skeletal, mixed Typic Haploboralls.

A typical pedon of Datino very stony fine loam, 55 to 70 percent slopes was described on the bank about 150 feet North of the old Mine portal about 300 feet North and 300 feet East of the SW corner of Section 24, T16S, R7E.

All - - 0 to 3 inches (0 to 8 centimeters); brown (10YR 5/3) very stony fine sandy loam, dark brown (10YR 3/3) when moist; moderate fine granular structure; soft, very friable, non-sticky, non-plastic; many very fine, few medium and coarse roots; moderately calcareous; moderately alkaline (ph 8.4); abrupt smooth boundary.

A12 - - 3 to 16 inches (8 to 41 centimeters); yellowish brown (10YR 5/4) stony fine sandy loam, dark brown (10YR 3/3) when moist; weak medium granular structure; soft, firable, non-sticky, non-plastic; many very fine and fine, few medium and coarse roots; 2 percent boulders, 10 percent stones, 10 percent cobbles, 10 percent gravel; moderately calcareous; moderately alkaline (ph 8.4); clear smooth boundary.

B2 - - 16 to 36 inches (41 to 91 centimeters) very pale brown (10YR 7/3) very stony sandy clay loam, pale brown (10YR 6/3) when moist; weak medium subangular blocky structure; slightly hard, firm, slightly sticky, plastic; common very fine and fine roots; many fine pores; 2 percent boulders, 15 percent stone, 15 percent cobbles, 10 percent gravel; moderately calcareous; strongly alkaline (ph 8.6); abrupt wavy boundary.

C1 - - 36 to 60 inches (91 to 152 centimeters) very pale brown (10 YR 8/4) stony silty clay loam, light yellowish brown (10YR 6/4) when moist; moderate medium and coarse subangular

blocky structure; hard, firm, sticky plastic; few very fine and fine roots, common fine pores; 2 percent boulders, 10 percent stones, 10 percent cobbles, 5 percent gravel; strongly calcareous; strongly alkaline (ph 8.9).

8.4 PRIME FARMLAND DETERMINATION

The entire permit area is deamned unsuitable for prime farmland based on:

1. There is no available water rights of an agricultural nature in conjunction with and of the land within the permit area.

2. The vast majority of the permit area is excessively steep to farm.

3. The nature of the soils (excessive rock) prohibit farming activities.

Based on all of the above the only conclusion possible is there are no Prime Farmlands within the permit area. See Appendix 8-C SCS Correspondance.

8.5 SOILS, PHYSICAL AND CHEMICAL PROPERTIES

Soil testing, where conducted on those soils in the permit area, are attached (see Appendix 8-4). Co-op is presently testing additional soil which has been purchased to relieve the deficiencies in the present stockpile. The results of these tests will be provided to the division on their return.

8.6 USE OF SELECTED OVERBURDEN MATERIALS OR SUBSTITUTES

Total estimate of topsoil stockpile in place as of 08/31/83, Co-Op Mine, Bear Canyon.

Tentative estimate of soil on hand is 2600 cubic yards. (See Plate 8-2). Additional material is anticipated with the completion of the bathhouse and shop grading. Total estimate of material necessary to cover those areas with 6" of soil where there is no available growth media on site is 6.2 acres. The balance of the 10 acres [3.8] has the native material available and redistributed on interim reclaimed areas or it is available as down east material along the pre-law existing road.

At present the mine is deficient approximately 2400 cubic yards. However, this material is available off-site. Co-Op has purchased in excess of 4000 cubic yards from R.D. Campbell property in Carbon County, Utah. The preliminary tests indicate the soil is comparable or better than what was present prior to disturbance. Co-Op has a "Life of mine, paid in full" lease on approximately 2 acres of fee property within 1 mile of the mine along the Bear Canyon County road (See Plate 8-3). Historically, the area has been utilized for recreation. At present, there is a baseball field, picnic area, and concrete dance pavillion (See photo, Figure 8.6-1). The existing soils on this site are marginal and despite several attempts at revegetation, are virtually bare. Co-Op is committed to relocating 3,324 yds. of soil. The intent is to distribute this material at a uniform depth of 4" over

an area of 75,600 sq. ft. (app. 924 cu. yds.). This material will be of a permanant nature and will be left in place at the conclusion of mining. An additional 2400 cubic yards will be distributed at a uniform depth on the ball field (See Fig. 8.6-2, cross section of substitute topsoil pile). This area will serve as a topsoil pile during the life of the mine, the field will have a clear water diversion ditch to prevent potential erosion and will be bermed until revegetation efforts preclude the potential of surface erosion.

A seed mix is designed for a rapid establishment of a turf suitable for recreational use as well as rapid establishment of a dense sod covering (See Table 8.6-1). A sprinkling system will be installed to insure both establishment and permanance. At the conclusion of the mining the surplus topsoil will be removed and redistributed on the mine property disturbance. The remaining 4" of soil will be revegetated utilizing the same methodology that the mine has committed to on the balance of their property to enhance both domestic and wildlife use.

The necessity for an alternative site off permit is justified by the following on-site conditions:

1. The Bear Canyon mine site is fully occupied with the existing structures.

2. There is no site within the permit boundary which could be utilized without massive additional disturbance.

3. Due to the critical winter range statute of the canyon bottom for Mule deer winter feed, any additional disturbance would be unwarranted.

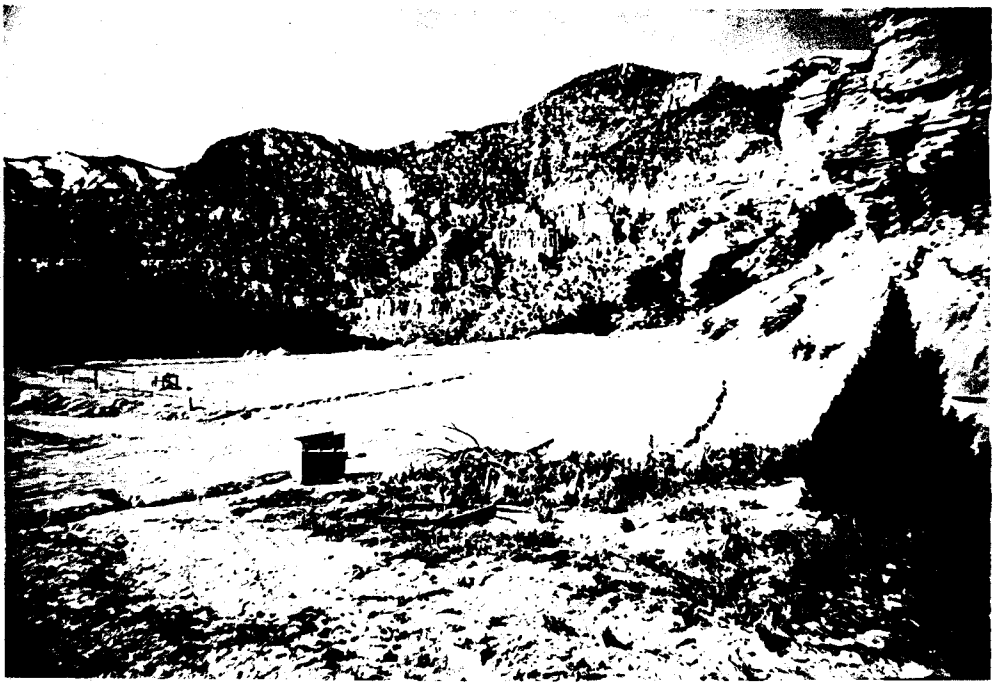
4. The vegetation established at the alternative site would enhance wildlife feed.

Table 8.6.-1

SEED LIST BALL PARK

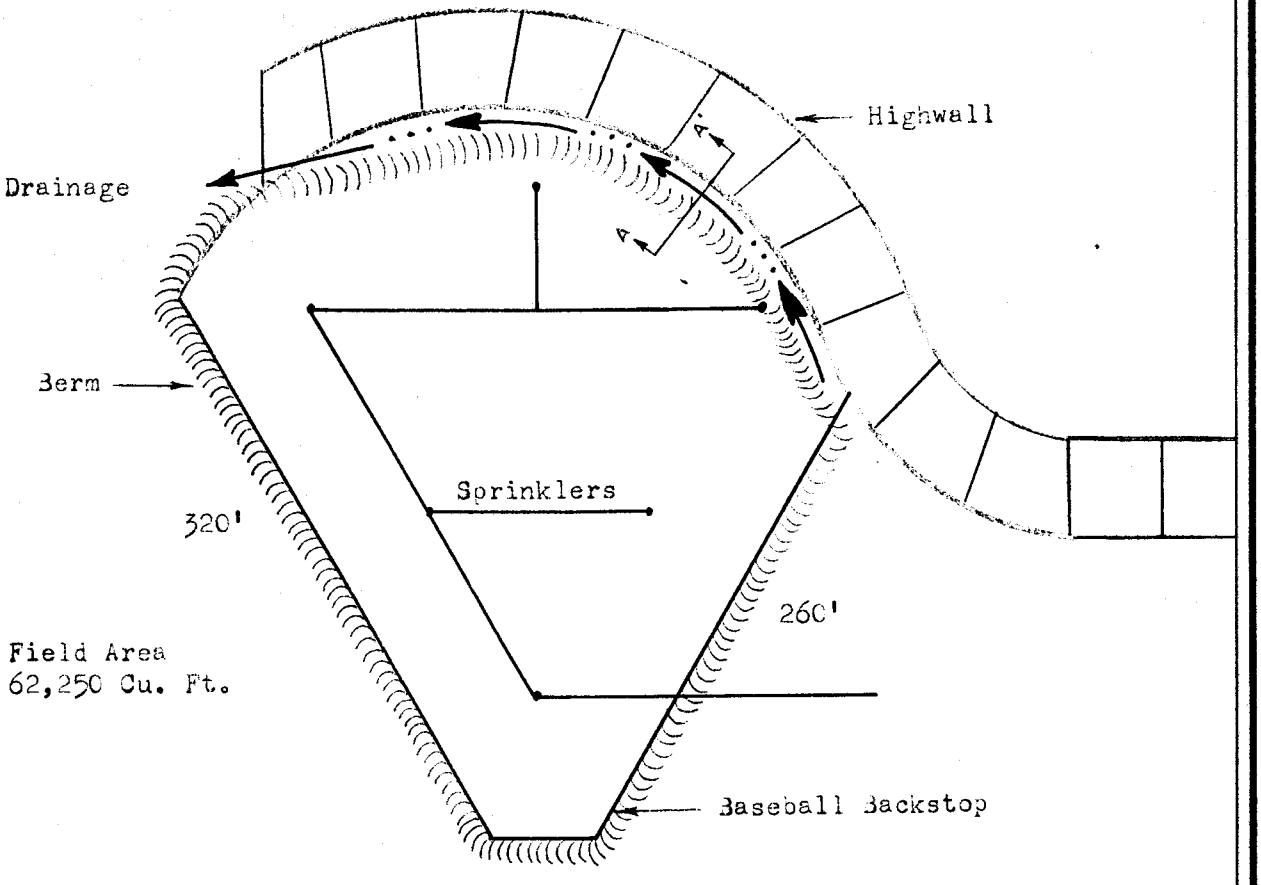
Poa pratensis	50#/acre
Festuca dasycloda	50#/acre

Figure 8.6.-1



PLAN VIEW

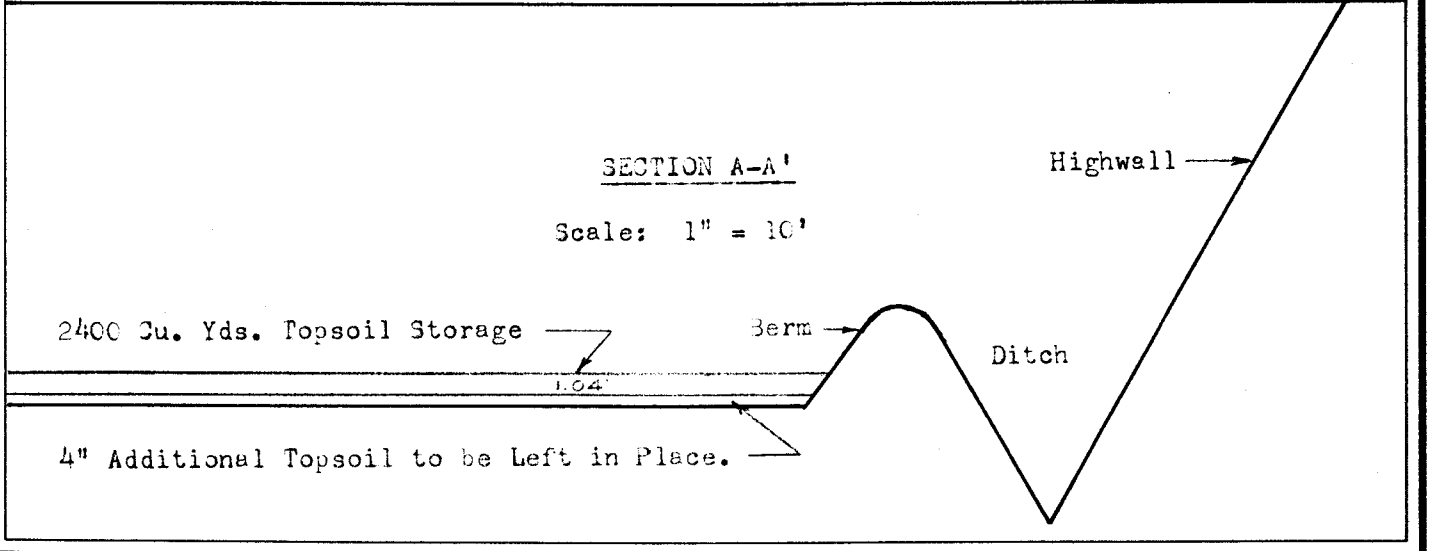
Scale: 1"=100'



PROPOSED TOPSOIL STORAGE AREA

SECTION A-A'

Scale: 1" = 10'



PROPOSED TOPSOIL STORAGE	BEAR CANYON	FIGURE NO. 8.6-2

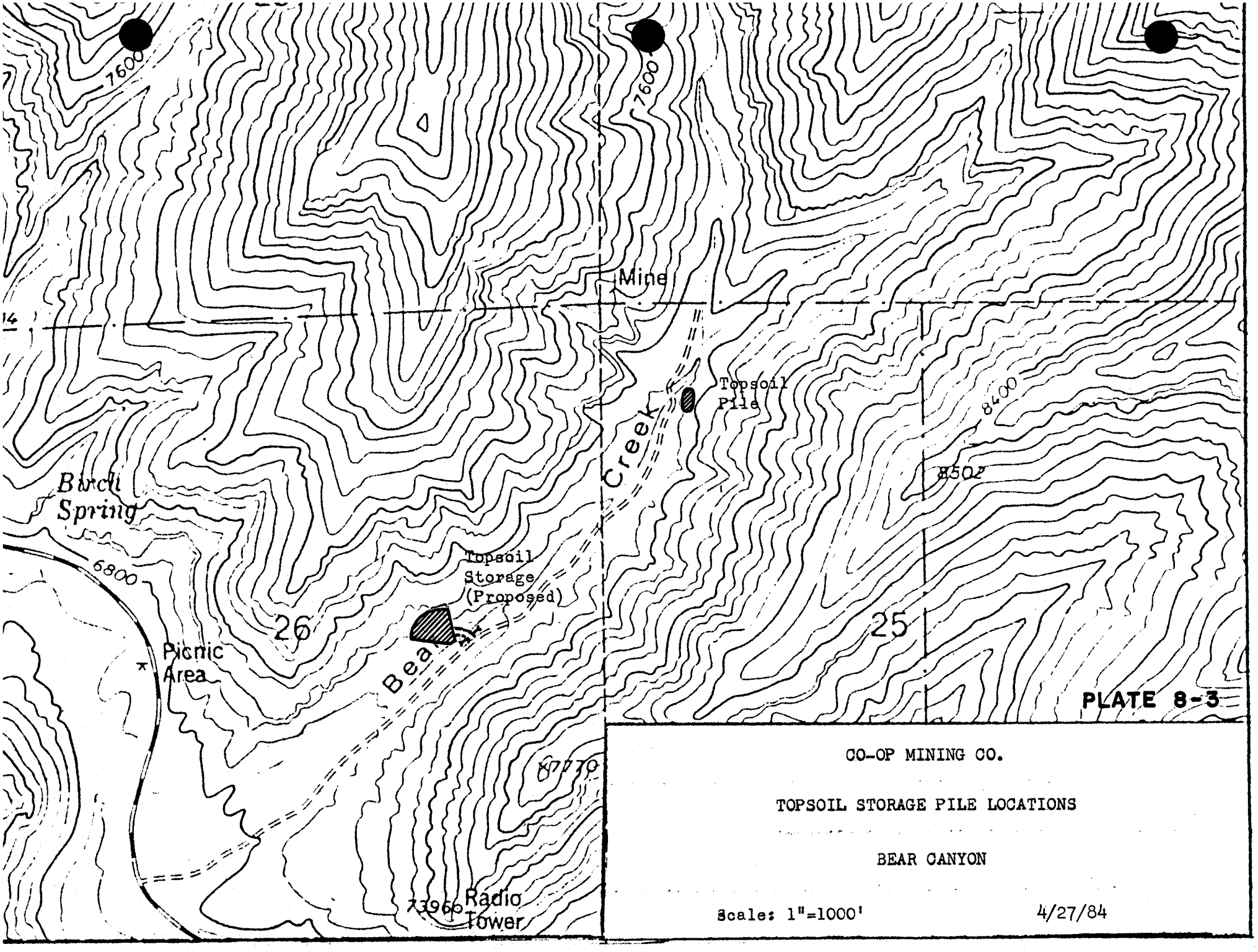


PLATE 8-3

CO-OP MINING CO.

TOPSOIL STORAGE PILE LOCATIONS

BEAR CANYON

Scale: 1"=1000'

4/27/84

8.7 PLANS FOR REMOVAL, STORAGE AND PROTECTION OF SOILS

SOILS, PHYSICAL AND CHEMICAL PROPERTIES OF SOILS; RESULTS OF ANALYSIS, TESTS, TRIALS AND INTERIM RECLAMATION PLAN.

The 1982 Co-op field investigations provided information on the physical and chemical properties of soils in the permit area. A Soils Legend will be included for each soil in a map unit (Plate 8-1). A rating for topsoil is included on this form as are some chemical properties. In studies during the 1982 field season an onsite sampling was analyzed for the required chemical properties in all horizons (see Appendix A).

SOIL REMOVAL, HANDLING, STORAGE, AND PROTECTION PLANS

To prevent suitable topsoil from being wasted or contaminated by waste materials, topsoil was removed from all new construction areas as a separate operation. The topsoil was stockpiled and will be consolidated and protected from wind and water erosion and contamination which might lessen its capability to support vegetation. The following subsections deal specifically with the varous phases of the top-

soil and subsoil handling plan.

Topsoil Removal

At the start of the construction phase, topsoil was collected from the area. Existing vegetation was removed and topsoil was collected prior to excavation or other surface disturbance operations within the affected areas.

The depth of topsoil removal in each case depends on the amount of A and B horizon material as defined in OSM Regulation 30 CFR 783.21 and 783.22. The topsoil removed in these areas consists of A horizon quality material and B horizon quality material with virtually no distinctive difference. The C horizon material was not removed since it was not sufficiently capable of supporting diverse vegetation due to the excessive rock.

The equipment used for topsoil removal consisted of bulldozers, front-end loaders, and dump trucks. The use of bulldozers requires pushing of the topsoil to a collection point for loading into dump trucks or other means of transportation to the de-

signated stockpile. Adequate supervisory personnel were present at the time of the topsoil removal to instruct the equipment operators in the proper techniques of topsoil removal and to ensure that required horizons were removed and stored.

Topsoil Stockpile

Topsoil is presently being stored within areas of the permit boundary (see Plate 2-2). It is the Co-op intent to consolidate Piles #3 with Pile #4; to utilize Pile #2 which is principally rock and unsuitable as a growth media as rip-rap where ever the need arises; and to relocate Pile #1 which is primarily rock to the site of Pile #4 to be used as a top dressing upon final reclamation.

The Piles have been consolidated (Appendix 3-D).

Plans involving topsoil storage can be labeled as "short term" or long term" depending on completion of activities in each area and the reclamation schedule presented. These piles should be considered "long term".

Short-Term Topsoil Storage Areas

Short-term stockpiles of topsoil will be for areas to be reclaimed almost immeadiately upon cutting and at final grade. Topsoil will be redistributed promptly to minimize natural degradation processes.

Long-Term Topsoil Storage Areas

During any new construction of areas that will be used for the duration of the mining operation within the permit area, topsoil will be collected and stockpiled. The topsoil will be used later for postmining reclamation of the abandonment areas.

Topsoil Protection

The short-term topsoil stockpile will be sprayed with water or temporarily vegetated to retard erosion. The long-term topsoil stockpile will be protected by the following operational steps:

A stable surface will be provided in an area outside the influence of active operations.

Short-term stockpiles of topsoil will be for areas to be reclaimed almost immeadiately upon cutting and at final grade. Topsoil will be redistributed promptly to minimize natural degradation processes. No short-term piles are anticipated at this time. If a need arises, a site-specific plan will be submitted prior to disturbance.

Long-Term Topsoil Storage Areas

During any new construction of areas that will be used for the duration of the mining operation within the permit area, topsoil will be collected and stockpiled. The topsoil will be used later for postmining reclamation of the abandonment areas.

Topsoil Protection

The short-term topsoil stockpile will be sprayed with water or temporarily vegetated to retard erosion. The long-term topsoil stockpile will be protected by the following operational steps:

A stable surface will be provided in an area outside the influence of active operations.

As a stockpile is completed, it will be left in a rough condition to minimize erosion.

Stockpiles will be situated out of drainages to prevent water erosion.

Storage piles will be vegetated with quick-growing, soil-stabilizing plants. Revegetation will involve the immediate seeding of stockpiles topsoil during the next planting season with the seed mixture recommended in a report on vegetation and plant community analysis (See Attachment 2A Seed List) in compliance with the requirements of the appropriate land management agency.

Signs will be posted to protect the stockpiles from accidental use as fill or from other inadvertent material contamination. The establishment of noxious plant species will be prevented.

The stockpiled topsoil will not be removed or otherwise disturbed until required for the redistribution operation on a prepared, regraded

disturbed area.

8.8 PLANS FOR REDISTRIBUTION OF SOILS

Prior to topsoil redistribution, regraded land will be scarified by a ripper-equipped tractor. The ground surface will be ripped to a suitable depth in order to reduce surface compaction, provide a roughened surface assuring topsoil adherence, and promote root penetration. Steep slope areas which must remain after abandonment will receive special ripping to create ledges, crevices, pockets, and screes. This will allow better soil retention and vegetation establishment.

Within a suitable time period prior to seeding, topsoil will be distributed on areas to be reclaimed. During this time, the topsoil will be allowed to settle and attain equilibrium with its natural environment. This procedure will be followed for areas in which facilities such as roadbeds, mine pads, and building sites are to be abandoned.

Topsoil redistribution procedures will ensure an approximate uniform thickness consistent with the pro-

posed reclamation plan. Topsoil will be redistributed at a time of the year suitable for establishment of permanent vegetation.

To minimize compaction of the topsoil following redistribution, travel on reclaimed areas will be limited. After topsoil has been applied, surface compaction will be reduced by using appropriate equipment running at a suitable depth. This operation will also help prepare a proper seed bed and protect the redistributed topsoil from wind and water erosion.

Co-op Mining will exercise care to guard against erosion during and after application of topsoil and will employ the necessary measures to ensure the stability of topsoil on graded slopes. The specific methods to be implemented will be defined in the attached Interim Plan. An example of the soil stabilization methodology that might be used includes the placement of crushed and heavier material at the toe of roadfill slopes, and the random placement of large rocks and boulders on the surface. This procedure will enhance the microclimate as well as make the reclaimed area more asthetically compatible with the

undisturbed surroundings.

8.9 NUTRIENTS AND SOIL AMENDMENTS

Phosphorus

Nitrogen

Soil ph and salinity

Soil texture

Chemical analysis for micronutrients will be conducted by testing soil extracts from the redistributed material. All necessary fertilization or neutralization, as determined by soil testing, will be done according to the final Reclamation Plan.

8.10 EFFECTS OF MINING OPERATIONS ON TOPSOILS, NUTRIENTS, AND SOIL AMENDMENTS

Since the Co-op Mine is an underground mine, the impact of mining on soils will be minor overall. The impacts of surface operations and mining facilities on soil resources consist of coverage of soil by landfills and refuse, disturbance of soils during construction activites, erosion created by removing vegetation, reduced forage growth due to nutrient degrada-

tion, reduced livestock capacity, and particulate emissions to the air.

The areas in which soil has been disturbed to date within the permit area, includes the loadout area, future offices, shops and substations, roads, portal areas, and the topsoil storage areas. Additional acreage may be disturbed in the future if Co-op elects to proceed with certain projects it is considering.

8.11 MITIGATION AND CONTROL PLANS

Detailed Interim Reclamation Plans (Appendix 3-C) are attached and are part of the Bear Canyon Mine Reclamation Plan in regard to stockpiling and long and short term plans and goals for final reclamation.

Co-Op is committed to take whatever steps ace necessary to minimize loss of soil through erosion. Whenever rills or gullies become in evidence, Co-Op will fill, regrade, rip rap and reseed, tackify, and mulch. This work will commence prior to significant loss. (Rills and gullies, less than 9").

APPENDIX 8-A

SOIL TEST REPORTS

SOIL TEST REPORT

NO. 7404.0

AGRICULTURAL CONSULTANTS, INC.

P.O. DRAWER 507 — 240 S. FIRST AVENUE
BRIGHTON, COLORADO 80601
303/659-2313

DATE RCVD 11-12-82

REPORTED 11-23-82

REPORT TO: CO-OP MINING COMPANY ATTN: MR. OWEN

BILL TO: SAME

GROWER: SAME

SAMPLE ID: BEAR UPPER PAD

TEXTURE si=silt, silty sa=sand, sandy lo=loam, loamy cl=clay	pH		CEC Meq /100g	SALT Mmhos /cm	Na Meq /100g	Lime %	OM %	Org N Lbs	AVAILABLE NUTRIENTS ppm (1)										
	H_2O	Buf							NO_3	P(2)	K(2)	Ca	Mg	S(2)	B	Zn	Fe	Mn	Cu
N LO	8.3	7.0	9.5	1.9	0.2	8.7	0.9	31.5	9	1	44	2700	250	58	0.2	0.4	1.5	1.1	0.

CROP	YIELD GOAL	CROP RESIDUE T/A	MNR T/A	RECOMMENDATIONS POUNDS PER ACRE											
				N	P_2O_5	K_2O	Elem Sulfer	Lime	Mg	SO_4-S	Boron	Zinc	Iron	Mn	Cu
DL Native Grasses	Average	-	0	50	80	70	0	0	0	0	0	0	0	0	0

1.ppm=parts per million or lbs element per million lbs soil. ppm x 2 = lbs/acre 6-7" depth. ppm x 3.5 = lbs/acre feet. 2. P x 2.3 = P_2O_5 K x 1.2 = K_2O S x 3

Values reported but without specific remarks are considered to be within growth range of intended crop.

If poor moisture conditions reduce fertilization accordingly.

Supervised by Diana Lyons

ATTACHMENT 1-A

SOIL TEST REPORT

NO. 7405.0

AGRICULTURAL CONSULTANTS, INC.
P.O. DRAWER 507 — 240 S. FIRST AVENUE
BRIGHTON, COLORADO 80601
303/659-2313

DATE RCVD 11-12-82

REPORTED 11-23-82

REPORT TO: CO-OP MINING COMPANY ATTN: MR. OWEN

BILL TO: SAME

GROWER: SAME

SAMPLE ID: BEAR POWER POLE

TEXTURE si=silt, silty sn=sand, sandy lo=loam, loamy cl=clay	pH		CEC Meq /100g	SALT Mmhos /cm	Na Meq /100g	Lime %	OM %	Org N Lbs	AVAILABLE NUTRIENTS ppm (1)										
	H_2O	Buf							NO_3	P(2)	K(2)	Ca	Mg	S(2)	B	Zn	Fe	Mn	Cu
	8.0	7.0	38.7	4.6	0.3	9.1	1.8	45.0	6	1	90	9900	510	204	0.6	0.4	4.6	1.4	0.

CROP	YIELD GOAL	CROP RESIDUE T/A	MNR T/A	RECOMMENDATIONS POUNDS PER ACRE											
				N	P_2O_5	K_2O	Elem Sulfer	Lime	Mg	SO_4-S	Boron	Zinc	Iron	Mn	Cu
DL Native Grasses	Average	-	0	50	50	90	0	0	0	0	0	0	0	0	0

1.ppm=parts per million or lbs element per million lbs soil. ppm x 2 = lbs/acre 6-7" depth. ppm x 3.5 = lbs/acre feet. 2. P x 2.3 = P_2O_5 K x 1.2 = K_2O S x 3

Values reported but without specific remarks are considered to be within growth range of intended crop.

If poor moisture conditions reduce fertilization accordingly.

Supervised by Diane Lyning

ATTACHMENT 1-A

SOIL TEST REPORT

NO. 7406.0

AGRICULTURAL CONSULTANTS, INC.
P.O. DRAWER 507 — 240 S. FIRST AVENUE
BRIGHTON, COLORADO 80601
303/659-2313

DATE RCVD 11-12-82

REPORTED 11-23-82

REPORT TO: CO-OP MINING COMPANY ATTN: MR. OWEN

BILL TO: SAME

GROWER: SAME

SAMPLE ID: SCALES BEAR

TEXTURE (si=silt, silty sa=sand, sandy lo=loam, loamy cl=clay	pH		CEC Meq /100g	SALT Mmhos /cm	Na Meq /100g	Lime %	OM %	Org N Lbs	AVAILABLE NUTRIENTS ppm (1)										
	H_2O	Buf							NO_3	P(2)	K(2)	Ca	Mg	S(2)	B	Zn	Fe	Mn	Cu
LO	8.3	7.0	11.1	1.0	0.2	8.6	1.3	45.5	8	3	99	3400	210	31	0.6	0.6	3.8	2.0	0.3

CROP	YIELD GOAL	CROP RESIDUE T/A	MNR T/A	RECOMMENDATIONS POUNDS PER ACRE											
				N	P_2O_5	K_2O	Elem Sulfer	Lime	Mg	SO_4-S	Boron	Zinc	Iron	Mn	Cu
DL Native Grasses	Average	-	0	40	50	50	0	0	0	0	0	0	0	0	0

1.ppm=parts per million or lbs element per million lbs soil. ppm x 2 = lbs/acre 6-7" depth. ppm x 3.5 = lbs/acre feet. 2. P x 2.3 = P_2O_5 K x 1.2 = K_2O S x 3
Values reported but without specific remarks are considered to be within growth range of intended crop.

If poor moisture conditions reduce fertilization accordingly.

Supervised by Dian Lansing

ATTACHMENT 1-A

APPENDIX 8-B

SCS SOIL SURVEY

SOIL SURVEY AND INTERPRETATIONS
VEGETATION SURVEY
for
CO-OP MINING CO.
Huntington Canyon
March 1980

Earl Jensen, Soil Scientist, SCS
George Cook, Range Conservationist, SCS
Gary Moreau, District Conservationist, SCS

TABLE OF CONTENTS

SOIL SURVEY AND INTERPRETATIONS
VEGETATION SURVEY
for
CO-OP MINING CO.

At the request of Wendell Owen, representing CO-OP Mining Co., and the San Rafael Soil Conservation District, the Soil Conservation Service performed a soil and vegetation survey on proposed mine property in Huntington Canyon. The surveys were designed to comply with the March 1979 Permanent Regulatory Program Requirements of the office of Surface Mining Reclamation and Enforcement, Department of Interior.

The survey covers approximately 23 acres on Bear Creek in Huntington Canyon, Emery County, Section 25, T16S, R7E, SLBM. The soils are shown on the attached map. Each soil is identified with a three letter symbol, and the pattern and extent are shown by the soil boundary lines on the map. It should be noted that the entire survey area had been disturbed from previous mining activities. Therefore, the soil characteristics were projected from the surrounding areas. All areas having the same symbol are essentially the same kind of soils. There may be small areas of other soils included within the delineation that are slightly different. The soils are named but have not been correlated. When the overall county survey is completed, small areas may become inclusions in other map units. Some names may change also. Included at the end of the report are the engineering uses and interpretations of the soils. The soil horizonation symbols, procedures, and nomenclature are as defined in the Soil Survey Manual (Ag. Handbook No. 18), National Soil Handbook of the Soil Conservation Service, and Soil Taxonomy.

SCS range conservationist, George Cook, visited each described soil in the survey area in November and recorded present vegetation and productivity according to ecological site analysis methods of the Soil Conservation Service. Present vegetation was recorded by percentage air dry weight. Estimates were made of annual production and range condition for the 1980 growing season. These findings are included in this report and the ecological sites identified on the soil map accompanying the soil report.

Most of the soils in the survey area are used as rangeland and wildlife habitat except where mine disturbances have occurred. On areas that have similar climate and topography, the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between soils and vegetation and water.

In this survey area the soils are grouped into ecological sites. An ecological site is an area or areas of rangeland or woodland uniform enough in climate, soils, drainage, exposures and topography that it supports a definite plant community that will produce a specific amount of vegetation. The kind of vegetation is generally the combination of plants that grew on the site before the range or woodland was affected by grazing, cultivation or otherwise altered and is called the potential vegetation. Normally the potential vegetation is the most productive combination of range or woodland plants that a site can support. Potential plant communities for the Bear Creek Canyon area obtained from clipping data, is not yet available from the Bureau of Land Management. As climate is a major factor in determining the potential plant community different climatic regime have been defined to facilitate the grouping of soils into ecological sites and the naming of sites. In this survey area there are two climatic regimes used. These are defined generally as follows:

Upland Climatic Regime - The average annual precipitation is 12 to 16 inches. Approximately 35 to 40 percent comes during the summer months. The growing period usually begins about April 1 and lasts until the first of November until moisture is depleted or the plants mature. The freeze-free season is 100 to 130 days, and the mean annual temperature is 47° to 50° F.

Mountain Climatic Regime - The average annual precipitation is 16 to 20 inches. Approximately 35 percent comes during the summer months. The growing season begins in the later part of April and lasts until the middle of October or until moisture is depleted or the plants mature. The freeze-free season is 80 to 110 days and the mean annual temperature is 44° to 47° F.

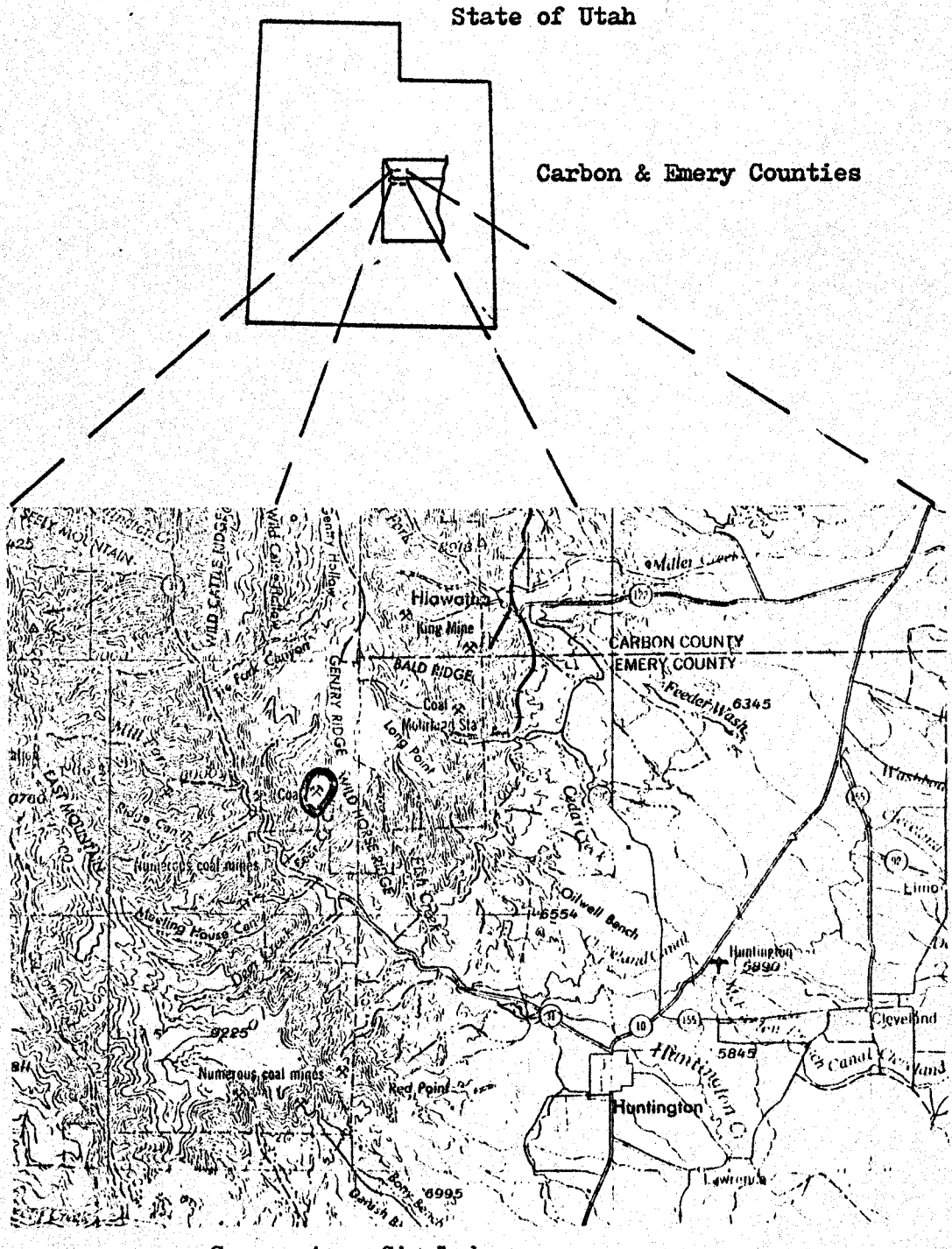
Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the exisitng community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site.

Such management generally results in the optimum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

More detailed information is available in the Price Field Office of the Soil Conservation Service.

LOCATION MAP
FOR
Soil Survey
of
CO-OP Mining Co.
Bear Canyon Area



Survey Area Circled

SOIL LEGEND

Soil Symbol	Soil Mapping Unit Name
D2E	Datino bouldery fine sandy loam, 5 to 20 percent slopes
D1G	Datino very stony fine sandy loam, 55 to 70 percent slopes

DESCRIPTION OF THE SOILS

D2E Datino bouldery fine sandy loam, 5 to 20 percent slopes.

This Datino soil is very deep and well drained. It occurs on moderately steep alluvial fans and some sloping flood plains at elevations of 7,100 to 7,140 feet (2,165 to 2,177 meters). This soil formed in alluvium and colluvium derived mainly from sandstone and shale. The average annual precipitation is 14 to 16 inches (36 to 41 centimeters). Mean annual air temperature is 42 to 45 degrees F. (5 to 7 degrees C.), mean annual soil temperature is 44 to 47 degrees F. (6 to 8 degrees C.), and the average freeze-free season is about 80 to 110 days.

Slopes are 5 to 20 percent and mostly east facing. They are short and concave-convex.

Vegetation is dominantly pinyon, Utah juniper, salina wildrye, squirreltail, big sagebrush, Douglas-fir, and Rocky Mountain juniper.

Included in mapping are small areas of a similar soil except with 20 percent gravel and cobbles in the surface layer.

In a typical profile the surface layer is brown, bouldery fine sandy loam and cobbly loam about 10 inches (25 centimeters) thick. The subsoil is light brown very stony loam about 28 inches (71 centimeters) thick. The substratum is light reddish brown cobbly fine sandy loam to a depth of 60 inches (1.5 meters) or more.

Permeability is moderate. Available water capacity is 6 inches (15 centimeters) to a depth of 60 inches (1.5 meters). Organic matter content in the surface layer is 4 percent. Effective rooting depth is about 60 inches (1.5 meters). Surface runoff is medium and erosion hazard is moderate under potential native vegetation and high if vegetation is removed and the soil is left bare. Erodibility is low. This soil is used for range, wildlife habitat, and mining operations.

Taxonomic classification is loamy-skeletal, mixed Typic Haploboralls.

A typical pedon of Datino bouldery fine sandy loam, 5 to 20 percent was described on the cut about 200 feet east and 1100 feet south of the NW corner of Section 25, T16S, R7E.

A11 -- 0 to 2 inches (0 to 5 centimeters) brown (10YR 5/3) bouldery fine sandy loam, dark brown (10YR 3/3) when moist; moderate fine granular structure; loose, very friable, slightly sticky, nonplastic; common very fine to medium, few coarse roots; 10 percent boulders, 10 percent stones, 5 percent cobbles, 10 percent gravel; slightly calcareous; moderately alkaline (8.0); abrupt smooth boundary.

A12 -- 2 to 10 inches (5 to 25 centimeters); brown (10YR 5/3) cobbly loam, dark brown (10YR 3/3) when moist; moderate medium granular structure; soft, friable, slightly sticky, slightly plastic; common very fine to medium, few coarse roots; 10 percent cobble and 10 percent gravel; moderately calcareous; moderately alkaline (ph 8.2); clear smooth boundary.

B2 -- 10 to 38 inches (25 to 96 centimeters); light brown 7.5YR 6/4) very stony loam, brown (7.5YR 4/4) when moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; common very fine to medium roots; 1 percent boulders, 30 percent stone, 10 percent cobbles, 20 percent gravel; moderately calcareous; strongly alkaline (ph 8.5); abrupt wavy boundary.

C1 -- 38 to 60 inches (96 to 152 centimeters) light reddish brown (5YR 6/4) cobbly fine sandy loam, reddish brown (5YR 4/4) when moist; massive; soft, very friable, slightly sticky, nonplastic; few very fine and fine roots; 10 percent cobbles, 5 percent gravel; strongly calcareous; strongly alkaline (ph 8.6).

AH3A

D1G Datino - Rock outcrop complex, 55 to 70 percent slopes.

This map unit is on very steep canyon sideslopes. Slopes are short and concave-convex, Elevation is 7,140 to 7,600 feet (2,177 to 2,318 meters). The average annual precipitation is 14 to 16 inches (36 to 41 centimeters). Mean annual air temperature is 42 to 44 degrees F. (6 to 7 degrees C.) and the average frost-freeze season is 80 to 110 degrees.

This unit is 75 percent Datino very stony fine sandy loam, 55 to 70 percent slopes in single and concave areas and 15 percent rock outcrop on ridges.

Included in this unit is about 10 percent of a shallow soil that is about 6 to 15 inches in depth, associated with the Rock outcrop.

The Datino soil is very deep and well drained. This soil formed in colluvium derived mainly from sandstone and shale. Slopes are 55 to 70 percent and east facing. They are short and concave-convex. Vegetation is dominantly pinyon, Utah juniper, Rocky Mountain juniper, salina wildrye, Douglas-fir, curlleaf mountainmahogany.

In a typical profile the surface layer is brown or yellowish brown, very stony fine sandy loam about 16 inches (41 centimeters) thick. The subsoil is very pale brown, very stony sandy clay loam about 20 inches (51 centimeters) thick. The substratum is very pale brown, very stony silty clay loam to a depth of more than 60 inches (152 centimeters).

Permeability is moderate to 36 inches (91 centimeters) and moderately slow below 36 inches. Available water capacity is 6.5 inches (16 centimeters) to a depth of 60 inches (1.5 meters). Organic matter content in the surface layer is about 4 percent. Effective rooting depth is about 60 inches (1.5 meters). Surface runoff is rapid and erosion hazard is high under potential native vegetation and very high if vegetation is removed and the soil is left bare. Erodibility is low. This soil is used for range, wildlife habitat, and mining operation.

Taxonomic classification is loamy-skeletal, mixed Typic Haploboralls.

A typical pedon of Datino very stony fine sandy loam, 55 to 70 percent slopes was described on the bank about 150 feet north of the old mine portal about 300 feet north and 300 feet east of the SW corner of Section 24, T16S, R7E.

All -- 0 to 3 inches (0 to 8 centimeters); brown (10YR 5/3) very stony fine sandy loam, dark brown (10YR 3/3) when moist; moderate fine granular structure; soft, very friable, nonsticky, nonplastic; many very fine, few medium and course roots; moderately calcareous; moderately alkaline (ph 8.4); abrupt smooth boundary.

A12 -- 3 to 16 inches (8 to 41 centimeters); yellowish brown (10YR 5/4) stony fine sandy loam, dark brown (10YR 3/3) when moist; weak medium granular structure; soft, friable, nonsticky, nonplastic; many very fine and fine, few medium and coarse roots; 2 percent boulders, 10 percent stones, 10 percent cobbles, 10 percent gravel; moderately calcareous; moderately alkaline (ph 8.4); clear smooth boundary.

B2 -- 16 to 36 inches (41 to 91 centimeters) very pale brown (10YR 7/3) very stony sandy clay loam, pale brown (10YR 6/3) when moist; weak medium subangular blocky structure; slightly hard, firm, slightly sticky, plastic; common very fine and fine roots; many fine pores; 2 percent boulders, 15 percent stones, 15 percent cobbles, 10 percent gravel; moderately calcareous; strongly alkaline (ph 8.6); abrupt wavy boundary.

C1 -- 36 to 60 inches (91 to 152 centimeters) very pale brown (10YR 8/4) stony silty clay loam, light yellowish brown (10YR 6/4) when moist; moderate medium and coarse subangular blocky structure; hard, firm, sticky plastic; few very fine and fine roots, common fine pores; 2 percent boulders, 10 percent stones, 10 percent cobbles, 5 percent gravel; strongly calcareous; strongly alkaline (ph 8.9).

DESCRIPTION OF PRESENT VEGETATION

Upland Stony Loam (Pinyon-Juniper) Ecological Site

Two inventories of the Upland stony loam (P-J) ecological sites in the Bear Canyon area recorded the following vegetation as a percentage of air dry weight:

1) Pit 1, SW¼, Sec. 24, T16S, R7E. This site relates to the D1G soil.

2) Pit 2, NW¼, Sec. 25. T16S, R7E. This site relates to the D2E soil.

	Percent	
Grass and Grass-like Plants	Pit 1	Pit 2
Indian ricegrass	5	5
Salina wildrye	25	10
Squirreltail		10
Sedge		2
Needleandthread		2
Muttongrass	T	1
Forbs		
Buckwheat	1	
Mustard	1	2
Aster	1	2
Other	2	2
Crytantha		2
Stickseed		2
Trees and Shrubs		
Rubber rabbitbrush		5
White fir	5	
Douglas fir	5	5
Pinyon pine	30	25
Juniper	10	10
Rocky Mountain juniper	10	5
Curlleaf mountainmahogany	5	
Big sagebrush		5
Elderberry		5
Total annual Production (estimated in pounds/acre)	900	1500
Ecological rating	Good	Good

Notes: Inventories were completed in November, 1980, making forb identification very difficult. The vicinity of Pit 2 appeared to have been burned in early 1900's. These sites were in a transition zone between upland and mountain climates.

Please insert this map (Plate 8-2) at the end of Chapter 8, Co-op Mining Company Bear Canyon MRP permit application of October 26, 1983.

Thank you

CHAPTER 9

VEGETATION

CHAPTER 9

VEGETATION

CHAPTER 9

TABLE OF CONTENTS

9.1 SCOPE

A reference area, approximately 1 or 2 acres in size was selected in July 1983 for the pinyon juniper grass and riparian vegetation types. The reference area was selected on the basis of similarity of species composition, cover, productivity, geology, soils, slope and aspect of the three vegetation types within the disturbed area defined at that time. This was done in conjunction with Mr. Lynn Kunzler of the Utah Division of Oil, Gas and Mining.

9.2 METHODOLOGY

A reconnaissance-type survey was conducted within the vegetation type that was disturbed, then correlated to reference areas in undisturbed areas. Surveys were conducted by a plant taxonomist during an initial sample period in August 1983. Additional species composition information was collected in conjunction with quantitative sampling in August 1983. Specific efforts were made to locate and identify species proposed or listed as threatened or endangered, noxious weeds and selenium indicators.

Sample Point Selection

Cover, shrub density and shrub height transects and tree density sampling points were located in pinyon juniper grass and riparian types on similar undisturbed areas using a random sampling technique. A random point was selected on the preliminary vegetation map

of the reference area for the first point. The direction and distance to subsequent points were randomly selected from the preceding point by using a random numbers tale. Each point was located in the field by pacing. Transect directions were randomly selected by compass bearings. The locations of sampling points were recorded and indicated on a site map.

Sample Adequacy Determination

Utah Division of Oil, Gas and Mining guidelines (1982) dictate the following sampling adequacy requirements for estimates of cover, shrub density and tree density:

grasslands - 90 percent confidence, 10 percent precision

shrublands and forests - 80 percent confidence, 10 percent precision

(Shrublands are defined as areas where shrubs contribute over 20 percent of the total cover.)

However, the guidelines require that a minimum number of samples be taken. The guidelines identify the maximum number if sampling adequacy is not met with fewer samples.

Vegetation Cover Estimation

Cover data was obtained at 50 points spaced at 1 meter intervals along a transect at each ranadomly selected sample point. A linear point-frequency frame (Mueller-Dombois and Ellenberg 1974) was used to accurately measure vertical hits on vegetation, litter-rock and bare ground. Crown or shoot cover was measured by counting only the first interception of the pin with a plant part. Overhead canopy cover was determined by recording the plant species hit when the vertical line of the pin was protected upward above the frame. Where crowns overlap in layered vegetation, the uppermost layer was considered the primary vegetation hit and subsequent hits on lower vegetation was recorded separately.

This technique provides frequency information for vegetative, litter-rock and bare ground components of total cover along a given transect. Frequency of individual plant species encountered along each transect was also determined to provide relative distribution information.

Shrub Density and Height Estimation

Shrub density and height were estimated along the same transects used for cover data. The height, number and species of shrubs whose stems rise within 50 centimeters on either side of the 50 meter transect was recorded. Shrub heights were measured and recorded by two classes: less than 1 foot and equal to or greater than 1 foot. All data was recorded on standard forms.

Tree Density and Basal Area Estimation

A total count of all trees within the reference area was done.

9.3 EXISTING RESOURCE

9.3.1 SCS Productivity Estimates

Productivity estimates and range condition for the reference were obtained from the local SCS Range Conservationist. (See Appendix 9-B.)

9.3.2 SAMPLING METHODOLOGY

Plant Cover: 38-50 meter transects; using a ten point frame at every 10 meter interval.

Shrub Density: 24 - 1 x 50 meter transects, counting all shrubs rooted within the sampling area.

Formula for Sample Adequacy:

$$\left(\frac{S\ t}{(0.1)\ (\bar{x})}\right)^2 = \frac{S^2\ t^2}{[(0.1)(\bar{x})]^2} = \text{number of samples needed (n)}$$

where:
t= 1.96 at 90% confidence (from t table)
s= standard deviation of sample
$\bar{x}$= mean of sample

For Cover: (numbers from cover summary sheet)

$$= \left[\frac{(8.60)(1.96)}{(0.1)(28.52)}\right]^2 = \left[\frac{16.856}{2.852}\right]^2 = 34.93$$

For Shrub Density: (numbers from Density Summary sheet)

$$= \left[\frac{(4.05)(1.96)}{(0.1)(19.13)}\right]^2 = \left[\frac{7.938}{1.913}\right]^2 = 17.22$$

Example calculation for deriving % vegetative composition:

Agsp $\frac{742}{38 \text{ transects}} = 19.5$ $\frac{19.5}{*\ 28.52} \times 100 = 68.37\%$ Agsp

all species' averages + bare ground + rock + litter = 100%
* All species averages totaled = 28.52

Example calculation for % shrub composition:

Chna $\frac{73}{24 \text{ transects}} = 3.04$ $\frac{3.04}{*\ 19.13} = 15.89\%$ composition

* 19.13 derived by adding all species averages.

9.3.3 Vegetation Types of the Co-Op Permit Area

Table 9-1 lists the vegetation types by total acres and acres of disturbance. Each type listed is described as follows:

Conifer Vegetation Types

The conifer vegetation type (Plate 9-1) occurs on steep north and west-facing slopes and on more moist areas of some south-facing slopes such as at the bottoms of the lower cliffs and between the riparian type and the lower fringes of the pinyon-juniper type. A mixture of conifer species such as Pinyon pine Pinus edulis, White fir Abies concolor, Douglas fir Pseudotsuga menziesii, and Utah juniper Juniperus osteosperma dominate the mature type. Primary understory species are Bluebunch wheatgrass Agropyron spicatum and Serviceberry Amelanchier alnifolia. Scattered Bristlecone pine Pinus longaeva occurs throughout the small valleys and along the edges of cliffs in the conifer type. Lightning and fire seared trees are scattered throughout this type. Browsing and grazing by native or domestic herbivores appears to be light in this type.

Grass Vegetation Type

The grass vegetation type (Plate 9-1) occurs on the small

Table 9-1

VEGETATION TYPES WITHIN THE BEAR CANYON PERMIT AREA AND POTENTIAL DISTURBED AREA

	Permit Area		Disturbed Area	
Vegetation Type	Acres	Disturbed	Drill Seeded	Hydro-Seeded
Conifer	139.06	-0-	-0-	-0-
Grass	62.73	-0-	-0-	-0-
Riparian	7.46	.67	.37	.30
Pinyon-Juniper	654.96	9.64	6.04	3.60
Sagebrush	4.3	-0-	-0-	-0-
Reclaimed	.65	-0-	-0-	.65
Bare	19.30	-0-	-0-	-0-
TOTAL	904.27	10.31	6.41	4.55

knolls and benches of the upper slopes in the potential disturbed area as well as on ridgetops within the permit area. This type is dominated by Salina wildrye Elymus salinus mixed with Bluebunch wheatgrass Agropyron spicatum and Wild buchwheat Eriogonum corymbosum. Trees or shrubs common in the surrounding conifer type occasionally occur within the grass type but the overall appearance of the area is one dominated by grass species.

Riparian Vegetation Type

The riparian vegetation type (Plate 9-1) occurs as a narrow band in the moist bottoms of canyons in the mine plan area. Although riparian species such as Narrowleaf cottonwood Populus angustifolia and River birch Betula occidentalis occur in the type, species such as White fir Abies concolor and Douglas fir Pseudotsuga menziesii, which are common in the surrounding conifer type, also dominate the riparian type. In some areas it is primarily the presence of the stream bottom and relatively robust growth from of the species that separate the riparian bottom from the surrounding conifer vegetation. Most of the vegetation cover in this type is provided by the trees. The understory in the riparian type consists of scattered shrubs such as Rocky Mountain juniper Juniperus scopulorum and Woods rose Rosa woodsii as well as a sparse cover of grasses and forbes. Use of the riparian type by native and domestic herbivores appeared to be light.

Pinyon-Juniper Type

"PJ" habitats, prevalent on south-facing slopes with rocky substratas of blocky sandstone, were extensive in the permit area (see the Vegetation Map, Plate 9-1). Most Pinyon/ Juniper areas were dominated by open stands of Pinyon Pine Pinus Edulis, Rocky Mountain Juniper Juniperus scopulorum, and Utah Juniper Juniperus osteosperma, with large Curl-leaf Mountain Mahogany Cercocarpus ledifolius. In a few places, the conifers were essentially lacking, resulting in a Mountin Mahogany "woodland." Many of the Mountain Mahogany more closely resembled small trees than shrubs being over 3 m high and having a single large trunk near the ground. Scattered Ponderosa Pine Pinus ponderosa and Douglas-fir Pseudotsuga menziesii were conspicuous in more mesic sites, especially valley bottoms, and Serviceberry Amelanchier sp. was occasionally present in significant numbers.

Prominent PJ understory species included Big Sagebrush Artemisia tridentata, Fringed Sage Artemisia frigida, Broom Snakeweed Xanthocephalum sarothrae, Salina Wildrye Elymus salinus, Indian Ricegrass Oryzopsis hymenoides, Skyrocket Gilia Gilia aggregata, and Gumweed Machaeranthera grindelioides.

Sagebrush

The sparse distribution of the sagebrush habitat type appears to be controlled by exposure and moisture availability. The largest stands of sagebrush occur in the flat lower drainages of Bear Creek Canyon. This habitat type merges on both sides of the canyon bottom, with the Pinyon/Juniper (See Vegetation Map, Plate 9-1).

Dominant vegetation species include Big Sagebrush Artemisia tridentata, Rubber Rabbitbrush Chrysothamnus nauseosus, Fringed Sage Artemisia frigida, Thistle Cirsium sp., Skyrocket Gilia Gilia aggregata, Plains Pricklypear Opuntia polyacantha, Cheatgrass Bromus tectorum, and Bluebunch Wheatgrass Agropyron spicatum.

Bare Cliffs and Talus

Vegetation is nonexistent or sparse and consists of a few grasses and forbs. Cliffs separate the Grassland vegetation type of the plateau from the more vegetated areas of the canyon bottoms.

9.4 Threatened and Endangered Species

No plant species listed as threatened or endangered (U.S. Fish and Wildlife Service, 1982) or proposed for threatened or endangered status

(Welsh and Thorne, 1979) was observed on the study area. No plants listed as threatened or endangered are known to occur in the Co-Op permit area (Thompson, personal communication, 1983).

9.5 RECLAMATION PLAN

Bear Canyon, Trail Canyon and associated disturbance

The following procedures are designed to revegetate and control erosion. They should, to a large degree, satisfy the commitments made by Co-Op Mining Company in their permit while also satisfying DOGM regulations as pertaining to interim reclamation and final reclamation for those areas which will be utilized after mining operations are concluded.

The areas in question are along and adjacent to the Bear Canyon Mine and Trail Canyon Mine access road and will be of a permanent nature.

The actual ground involved comprises approximately 10 acres of disturbed land primarily road and deck areas. The actual procedures involve a four phase program; [1] earthwork, [2] hydromulch the entire area to supplement revegetation and control run-off until stabilization is complete, [3] prepare a site which will be stable enough for a period of time to allow vegetation to become established, and [4] to plant seedlings to further stabilize the soil and to provide necessary wildlife, hydrological and aesthetic commitments as detailed in mine reclamation permit.

PHASE 1 - Earthwork - Original Contour

The roads and pads will be brought back to a reasonable configuration by implementation of a large backhoe unit in conjunction with a crawler tractor (JD450). The actual method will involve the pulling of material from approximately ten feet below the road cut up onto the road surface and spreading and compacting this material with the crawler tractor, at the same time pulling the leading edge of the high wall down to lessen the degree and angle of the high wall. All work done, both above and below the road, will take into consideration existing vegetation and all effort will be made to minimize disturbance where possible. When there is no alternative other than disturbance, an effort will be made to relocate earth and maintain existing vegetation in place; attempting to relocate the vegetation in the proximity of the road disturbance. (See Attachment 2). The material redistributed to regain original contour will be compacted to approximately 95% of the original or adjacent undisturbed soil. Upon completion of this step of spreading and compacting, the unconsolidated native material will approach the original configuration of the site prior to disturbance. The native topsoil which was removed from the area will be redistributed to a depth of 6 inches, as indicated by Soil Survey - March 1980. Upon redistribution of the A horizon soil, all associated compaction resulting from spreading will be alleviated by ripping the entire area to a depth of 20 centimeters to enhance the revegetation effort.

PHASE 2 - Seeding and Mulching

The entire area of disturbance will be drilled and hydroseeded during the first Fall following the complete abandonment and earth work. (September through November). Spring seeding was considered too speculative to be implemented based on the variation in Spring moisture regimes.

The largest portion of the recontoured site will facilitate drill seeding In order to lessen compaction, a rangeland drill seeder pulled behind a small crawler tractor will be utilized. A tentative estimate of the area to drill seed is approximately 6.5 acres. The balance of the area would then be hydroseeded. The seed mix and rate of application is attached.

In combination with the seed, the following rates of tackifyer will be utilized:

[Rates of Tac were developed with respect to velocity and erosive power of water which is proportional to the square root of the slope.] An emperical factor was determined from laboratory and field studies to arrive at the minimum Tac fiber ratio. Thus, 60 pounds of Tac per ton of fiber is about minimum for slopes up to 20% and the emperical factor is determined as $60 \div 20\% = 12$. A 25% slope is about maximum for the minimum amount of Tac. For a 100% slope [1:1 or 45°] the ratio of Tac to fiber is calculated as:

[100%] [12] = 120 pounds.

SUGGESTED RATIOS OF TAC TO FIBER FOR HYDROSEEDING AND HYDROMULCHING TO SERVE AS MULCH OR SOIL BINDER

SLOPE ANGLE	SLOPE RATIO rise:run	PERCENT SLOPE	LBS. TAC PER TON FIBER	RATIO TAC TO FIBER
14°	1 : 4	25%	60[minimum]*	1 : 30
26°	1 : 2	50%	80	1 : 25
33°	1 : 1½	66%	100	1 : 20
45°	1 : 1	100%	120	1 : 16
57°	1½ : 1	150%	140	1 : 14
64°	2 : 1	200%	160[minimum]	1 : 12

* 60 pounds is suggested as a minimum to insure excellent stabilization; however, in many conditions 40 pounds of Tac per acre has given excellent results on a 1:4 or less slope.

The minimum specifications for both Tac and mulch are included under Attachment 5.

Following the seeding effort the entire area of disturbance will be hydromulched and fertilized. The rate of application of the mulch is:

1,200 to 1,500 lbs/acre on 1:1 slopes

2,000 to 2,500 lbs/acre on 3:1 slopes

The mulch will also be fortified with Tac as previously indicated according to slope. Incorporated in the mulch slurry the following rate of fertilizer will be applied per acre:

80 lbs. N/acre

100 lbs. P_2 0_5/acre

100 lbs. K_2 0_5/acre

Approximately 50% of the above application will be incorporated in the mulch and the balance be added as an over-spray the following Fall. Recommendation on fertilizer requirements is based on soils test.

PHASE 3 - Site Preparation

Site stability will be largely accomplished through the grading, compacting and the utilization of a tackifying agent. However, on those areas with slopes of more than 2:1, the following procedures will add an additional parameter of stability and enhance the revegetation efforts.

Site preparation is both general and specific in procedures. The sites and methods provide a multitude of purposes and to a large degree are residual for several years. First and foremost, they effectively decrease the angle of repose of the slope in question. In accomplishing this you effectively modify the site and change those conditions which preclude vegetation from becoming established. Second, you change the severity of erosion and, in facat, use those surface waters which heretofore were destructive in nature. This is accomplished by creating basins wherein the water has time to soak in and thus can be utilized by vegetation.

By utilizing a small crawler tractor (JD450) terraces can be contoured on all slopes in excess of 2:1. The resulting terrace creates a bench effect and are spaced at 12" intervals down the slope. A terrace of 8' toed toward the hill is thus created. Planting is then instigated at approximately 2' distance from the cut face to minimize the detrimental effect of potential sluffing. On a small portion of the disturbed area it may be necessary to utilize hand labor to construct small terraces, approximately 18" benches on a contour of 4' intervals. These terraces are constructed utilizing a "Region 6" hand tool and would only be implemented in areas deamed hazardous for equipment and or in sensitive areas such as along Bear Creek where down east material could adversely effect the drainage. This, in turn, decreases the impact on adjacent watersheds and improves quality of surface waters. Those areas which are terraced provide a more favorable ecosystem than that of an equivalent slope. It facilitates better

utilization of grasses and forage for grazing animals; to some degree it modifies climate in that severity of wind and weather is somewhat diminished. Also, the cut face acts in much the same as a snow drift fence does in trapping and causing small areas of snow retention

PHASE 4 - Planting

The planting of seedlings will be done within 2 years of the seeding effort in order to evaluate the number and species of seedlings necessary to insure both composition and stocking of woody species to maximize utilization by wildlife and domestic grazing.

The species and numbers of individual plants are correlated to the reference area which was established during July of 1983. Stocking is discussed on page 3-99 and listed in Section 9.5.1.1 end of seed list.

Planting Procedure

Planting will be done utilizing a powered auger with a capability of drilling a 3 inch plus diameter hole to a depth of 16 inches. The roots of the sedling will be arranged in as near natural position as possible paying special attention not to "J" the root tips. (Fig. 9-1).

By holding the seedling at the root crown, soil will be compacted back around the roots being careful to leave no air pockets or loose dirt (which would constitute settling). The tree will be firm when

light pressure is exerted on the needles and standing in an errect position. Only hands shall be used to pack soil around the tree - the use of a stick or foot is strictly forbidden.

At all times the trees will be protected from direct sun light and special care will be exhibited when lifting the seedling from the planting bag to the prepared hole. The spacing of planted shrubs and trees will be to obtain the desired density and diversity while providing small clumps of cover for wildlife on approximately 100' intervals throughout the areas of disturbance that are in excess of 2 acres in size.

Field Storage

Field storage facilities are illustrated in Fig. 9-2. In the event snow is not available, a similar cache can be constructed using wet burlap and damp straw.

The mine will have to maintain a sorting, packaging and storing tent at the cache site. A sorting table will need to be set up in one tent. Each seedling must be examined and all that do not have a 2 to 1 crown to root relationship or are damaged must be discarded. The seedlings then need to be dipped in a vermiculite slurry and then rolled in wet burlap and placed in canvas planting bags.

The trees can only be left in the bags for twenty-four hour periods and then must be repacked following the same procedures.

The field handling of packed trees requires the crowns be kept moist and the bags covered with insulated tarps and stored in shaded areas.

During breaks, lunch, etc., the crews planting bags must be placed in shaded areas. At the end of each operational day all bags must be unpacked and the trees redipped in vermiculite and rerolled in wet burlap and repackaged to be used first the succeeding day.

Upon completion, the reclaimed area will be monitored to determine when bond release parameters are achieved. If the monitoring indicates inadequacies, the area will be supplemented with additional efforts.

The monitoring procedures will be the same sampling methodologies which will be incorporated in establishment of reference areas.

9.5.1 RECOMMENDED SEED MIX

BEAR CANYON MINE - CO-OP MINING COMPANY

RIPARIAN - CREEK BOTTOM

GRASSES	LBS/ACRE P.L.S.
Oryzopsis hymenoides	10
Stipa comata	2
Bromus tectorum	6
FORBS	
Clematis columbiana	2
Arnica cordifolia	1
Arlemisia dracuncalus	3
Equisetem spp.	4
Apocynum androsfe	2.5
SHRUBS	
Rosa woodsii	4
Rhus trilobata	2.6
Prushia tridentata	.4
Chrysothamnus nauseosus	.5
	45 lbs. per acre

Rates are designed for hydroseeding

Drill seeded area would be $\frac{1}{2}$ the listed application rate.

Species to be planted:

SPECIES	LINEAR FOOT SPACING	NUMBER PER ACRE
Populus angustifolia	5'	1,072.
Rosa woodsii	8 x 8'	680.

9.5.1.1 RECOMMENDED SEED MIX

BEAR CREEK MINE - CO-OP MINING COMPANY

PINYON JUNIPER GRASS

SPECIES	P.L.S. LBS./ACRE	APP. NO. SEEDS/FT^2
GRASSES		
Agropyron dasystachyum Thickspike wheatgrass	3	12
A. spicatum Bluebunch wheatgrass	8	22
Elymus salina Salina wildrye	1.5	15
Oryzopsis hymenoides Indian ricegrass	3	12
Poa secunda Sandberg bluegrass	1	21
FORBS		
Achillea millifolium Western Yarrow	.15	10
Aster chilensis Pacific aster	.15	9
Hedysarum boreale Northern sweetvetch	9	7
Lupinus sericeus Silky sweetvetch	20	6
Penstemon palmeri Palmer penstemon or P. strictus Rocky Mountain penstemon	.5	7

SHRUBS

Amelanchier Utahensis Utah serviceberry	4	4
Artemisia tridentata ssp. vaseyana Big sagebrush	.15	9
Cercocarpus ledifolius Curlleaf Mountain mahogany	6	7
Chrysothamnus nauseosus var. albicaulus Whitestem rubber rabbitbrush	.5	5
Sambucus cerulea Blue elderberry	.8	4
For hydroseeding	59.75	159
$\frac{1}{2}$ application for drill seeded areas	30.00	

After 2 years the seeding effort will be evaluated and planting will be instigated in the event it appears necessary to bring the density and diversity of woody species up to the confidence levels of the corresponding reference area. The same species will be planted as listed above under shrubs. In addition, the following tree species will be planted:

SPECIES	NUMBER PER ACRE	SPACING WITHIN CLUMPS*
Pinus edules	15	5'
Juniperus osteosperma	15	5'
Juniperus scopulorum	5	25'

* Clumps spaces at 30 yd. intervals for wildlife cover

9.5.1.2

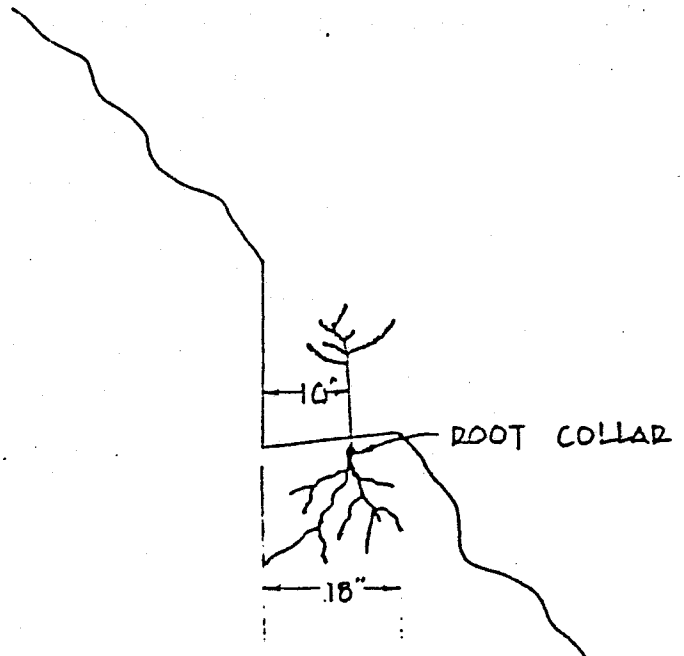
REVEGETATION
ESTIMATE OF RECLAMATION COSTS ON
BEAR CANYON AND TRAIL CANYON MINE DISTURBANCE

All costs are based on known costs - contract amount on work either in progress or completed in the preceding 12 months.

TYPE OF ACTIVITY	COST PER ACRE
Hydromulching and Seeding:	
Application of seed and tackifyer; equipment and labor only	$ 175.00/acre
Application of mulch, fertilizer and tac; equipment and labor only	275.00/acre
Mobilization [Utah Area]	Job 500.00
Mulch	380.00/acre
Tac @ $1.60/# 140#/acre	224.00/acre
Fertilizer @ $23.00/100#	23.00/acre
Drill Seeding	240.00/acre
JD 450 Crawler @ $45.00/hour estimating 8 hours/acre	360.00/acre
Case 580 Backhoe @ $35.00/hour estimating 24 hours/acre	840.00/acre
Seed	
Variable - current quote	165.00/acre
Planting and Site Preparation	93.00/acre
Nursery Stock	.50/each

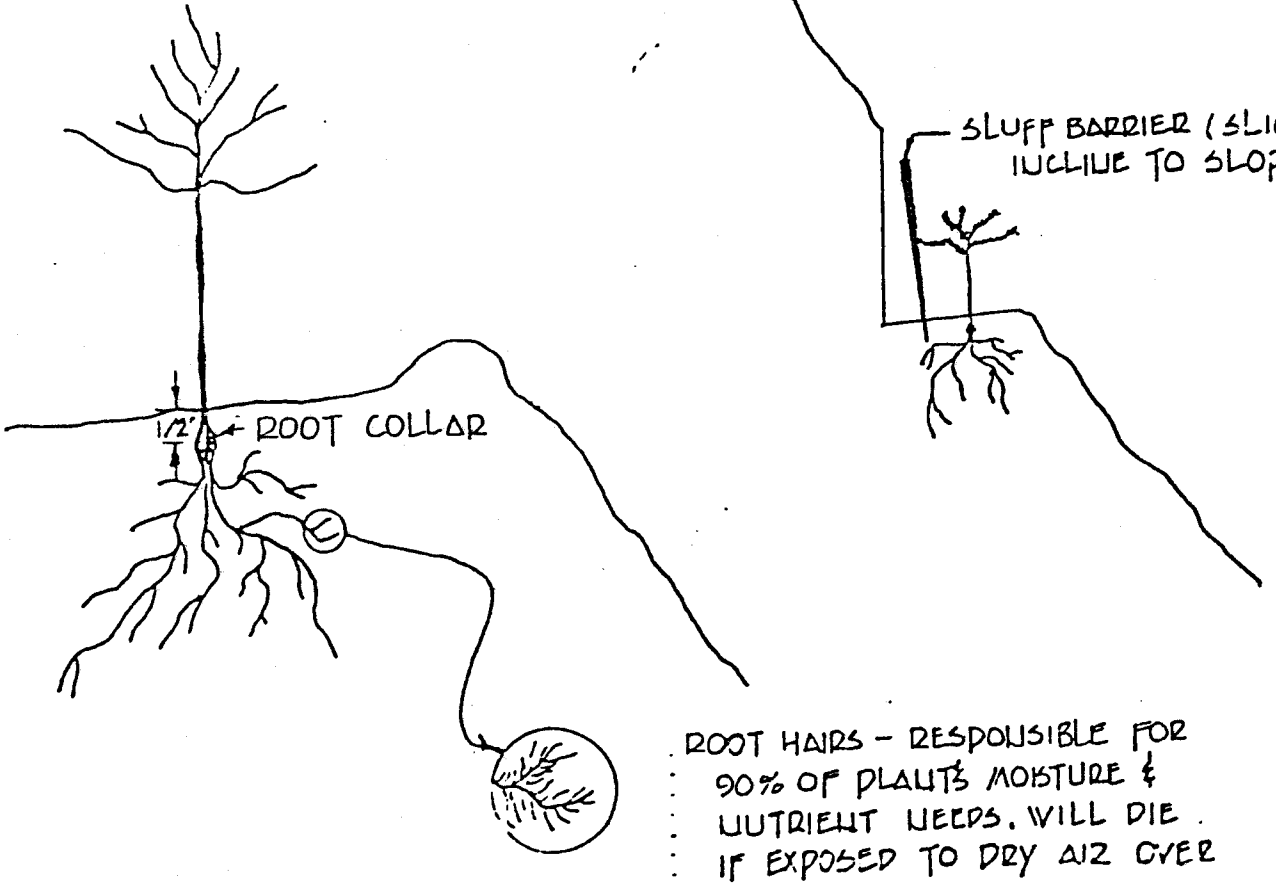
CORRECT PLANTING PROCEDURES
(GRADED SLOPES)

Fig. 9-1



NOTES:

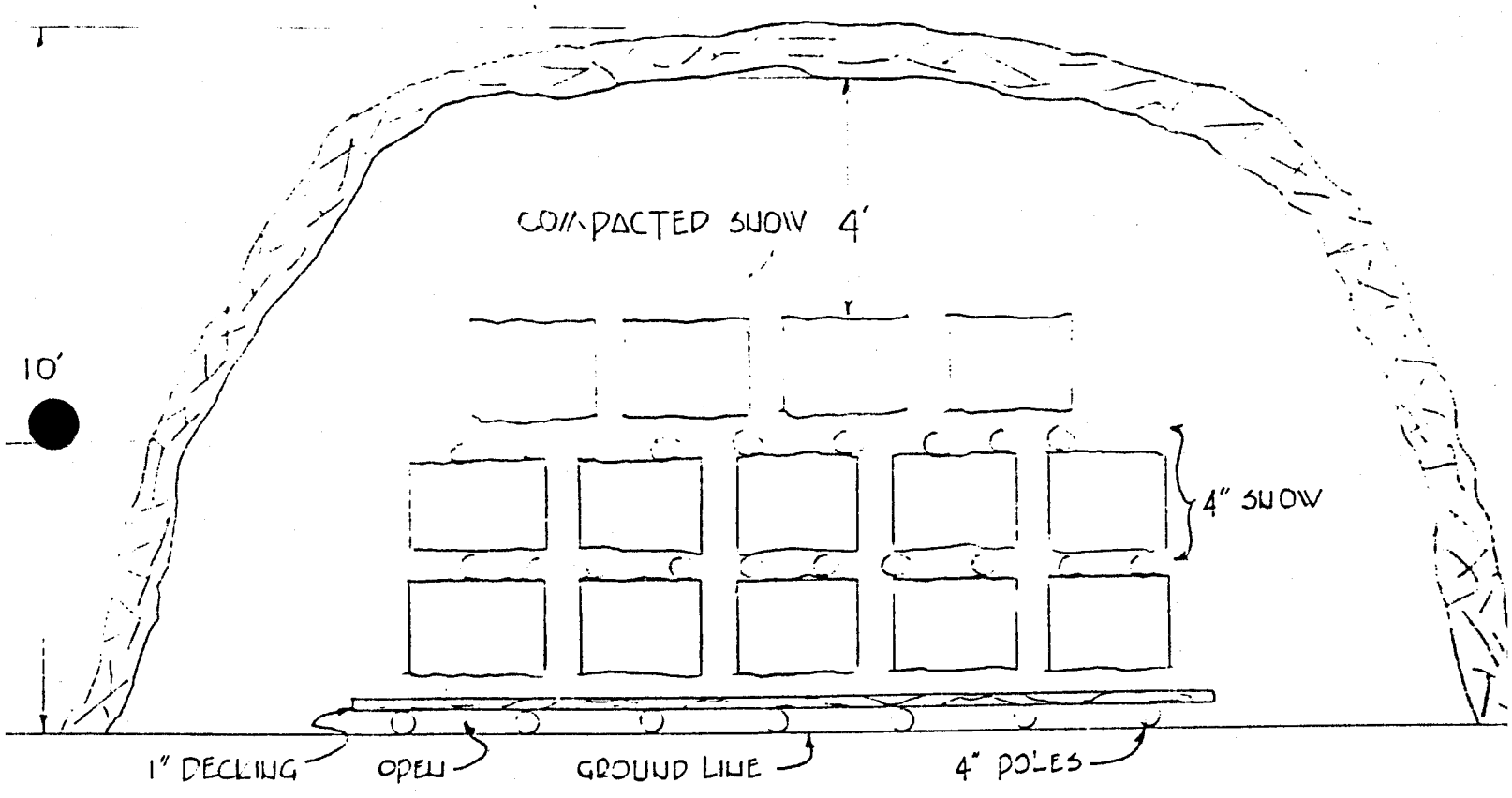
1. STEM PLANTED IN VERTICAL POSITION
2. PLANT STEM 10" FROM VERTICAL CUT OF SCALP
3. ROOTS ARE STRAIGHT AND SPREAD IN A NATURAL PATTERN
4. SOIL IS FIRMLY PACKED SO NO AIR POCKETS EXIST
5. ROOT COLLAR IS COVERED BY AT LEAST ½" OF SOIL
6. ROOTS PROTECTED FROM DRYING



ROOT HAIRS - RESPONSIBLE FOR 90% OF PLANTS MOISTURE & NUTRIENT NEEDS. WILL DIE IF EXPOSED TO DRY AIR OVER

9-26 15 SECONDS

Seedling Storage



SNOW CACHE WILL MAINTAIN SEEDLINGS AT 32°F. AND REALATIVE HUMIDITY OF 100%. SEEDLINGS SHOULD BE PLACED IN A COOL SHADED AREA 24 HOURS PRIOR TO PLANTING.

Fig 9-2

Melvin A. Coonrod
Co-Op Mining Company
P.O. Box 1245
Huntington, Utah 84528

August 20, 1983

Utah Division of Oil, Gas & Mining
Mr. James Smith
4241 State Office Building
Salt Lake City, Utah 84114

REF: ACR Committment July 29th 1983
Vegetation Analysis-Reference Area
Co-Op Mining Co. Bear & Trail Canyon

Dear Jim:

Please find attached: The data, work sheets and Summation on the Vegetation Reference Area. The area was selected in cooperation with Mr. Lynn Kunzler of the Division, and myself. The work was completed during August 6-7, 1983, and appears to be very representative of those areas which were disturbed in conection with mining activities in both Trail and Bear canyons.

The commitment to do this work was referenced in the Bear Canyon Scale modification, Bear Canyon Pad modification, and the Bear Canyon Apparant Completeness submittal. It was also referenced in the various reclamation plans I have submitted relative to the Co-Op's activities.

In view of this, I have attached eight copies. I would appreciate your assistance in diseminating this data.

I would again wish to express the Co-Op's appreciation for the Divisions' assistance in helping establish these areas.

Sincerely,

Melvin A. Coonrod
Permitting & Compliance Director
Co-Op Mining Company

Attachments: dup 8

CO-OP REFERENCE AREA - SUMMATION

PINYON-JUNIPER GRASS

AVERAGE COVER	% of VEGETATIVE COMPOSITION	GRASSES	SPECIES	COMMON NAME
19.5	68.37	Agsp	Agropyron spicatum	blue bunch wheat grass
		Orhy	Oryzopsis hymenoides	indian rice grass
		FORBS		
.05	.18	Hyri	Hymenozys spp.	
.05	.18	Stpi	Stanleya pinnata	prince's plume
.3	1.05	Arlu	Artemisia ludoviciana	louisiana sagewort
		Astra	Astrogalus spp.	milkvetch
		Chdo	Chaenactis douglosii	false yarrow
		Erige	Erigeron spp.	fleabane
.05	.18	Haplo	Happlopappus spp.	goldenweed
.05	.18	Saka	Salsola kali	russian thistle
		SHRUBS		
.11	.39	Artr	Artemisia tridentata	big sagebrush
.5	1.75	Epvi	Ephedra viridis	mormon tea
5.4	18.93	Eriog	Eriogonum spp.	buckwheat
.9	3.16	Gusa	Gutierrezia spp.	snakeweed
1.4	4.91	Chna	Chrysothamnus nauseogus	rubber rabbit brush
.2	.71	Opun	Opuntia spp.	prickly pear
28.52	100			

NUMBER ON SITE GREATER THAN 5 FEET TALL	TREES		
7	Juos	Juniperus osteosperma	Utah juniper
2	Jusc	Juniperus scopulorum	rocky mountain juniper
7	Pied	Pinus edulis	pinyon pine
0	Pipu	Picea purguns	blue spruce
0	Cemo	Cercocarpus montanus	true mountain mahogany

28.52	Total Vegetation	Size of PJ grass area:
13.8	Bare ground	78 X 210'
46	Rock	
11.7	Litter	
100.%		

RIPARIAN BENCH - CO-OP REFERENCE AREA

% Of Total Cover

FORBS		SHRUBS	
Arnica cordifolia	1	Chrysothamnus nauseosus	5
Clematis columbiana	5	Astragalus spp.	2
Tragopogon dubius	< 1	Artemisia frigida	1
Ipomopsis aggregata	< 1	Gutierrezia spp.	1
Castilleja spp.	< 1	Purshia tridentata	10
Circium spp.	< 1	Ephedra vividis	< 1
Hackelia floribunda	< 1	Chrysothamnus viscidiflorus	1
Artemisia dracuncalus	2	Opuntia spp.	< 1
		Symph spp.	< 1
	10%		20%

GRASSES	
Poa pratensis	3
Oryzopsis hymenoides	2
Stipa comata	15
Bromus tectorum	5
	25%

Total size of area - 50' X 78'

Total vegetation	55%
Bare ground	10%
Rock	20%
Litter	15%

* RIPARIAN "STRIP" - CO-OP REFERENCE AREA

(Very narrow, steep slopes)

% Of Total Cover

FORBS	
Circium spp.	2
Equisetem spp.	25
Clematis columbiana	5
Lathyrus spp.	2
Taraxacum officinale	< 1
Smiliacena spp.	1
Apocynum androsfemifolum	8
	43%

GRASSES	
Juncus spp.	1
Bromus marginatus	< 1
Agrostic spp.	1
Poa spp.	< 1
	2%

SHRUBS	
Rosa woodsii	14
Rhus trilobata	1
	15%

Vegetative total	60%
Bare ground	5%
Litter	20%
Rock	15%

*The riparian zone is so small that an adequacy was impossible to obtain.

SHRUB DENSITY

$$/ha = \frac{N}{24} \text{ transects } X\ 200$$

SHRUBS	NUMBER OF	% of SHRUB COMPOSITION
Artemisia tridentata	16	.42
Chrysothamnus nauseosus	608	15.89
Ephedra viridis	566	14.79
Eriogonum spp.	2108	55.10
Guaiacum sanctum	350	9.15
*Juniperus osteosperma	16	.42
*Juniperus scopulorum	8	.21
Opuntia spp.	8	.21
*Pinus edulis	75	1.96
*Pinus monophylla	16	.42
Rosa woodsii	25	.78
Purshia tridentata	16	.42
Tamarix pentandra	8	.21
	Total shrubs /ha 3820	99.98%

All shrubs rooted within the sample area.

*Tree species included due to their shrub-like nature less than 5' in height.

TREE DENSITY

A total count of all trees within the reference area was made indicating a density of:

		# Per Acre
Juniperus osteosperma	7	14
Juniperus scopulorum	2	5
Pinus edulis	7	14

BEAR CANYON SITE - SIMILARITY COMPARISON

GRASSES

Agropyron spicatum
Oryzopsos hymenoides

SHRUBS

Artemisia ludoviciana
Artemisia tridentata
Chrysothamnus nauseosus
Ephedra viridis
Salsola kali
Chrysothamnus douglasi
Opuntia spp.

TREES

Juniperus osteosperma
Juniperus scopulorum
Pinus edulis
Cercocarpus montanus

Bare ground
Rock (slightly more)
Litter

This area is very similar in coverage to the sampled reference area. The only difference is there is slightly more Artr and rock on this area.

All data and calculations were collected and compiled by Larry Germain, Paige Waldvogel in cooperation with Mel Coonrod.

Table
PLANT SPECIES IDENTIFIED ON OR ADJACENT TO
THE PERMIT AREA (7/82)

PLANT SYMBOL	SCIENTIFIC NAME	COMMON NAME
GRASSES		
Agsm	Agropyron smithii	western wheatgrass
Agtr	Agropyron trachycaulum	slender wheatgrass
Agin	Agropyron intermedium	intermediate wheatgrass
Agex	Agrostis exarata	red top
Avba	Avena barbata	wild oats
Bogr	Bouteloua gracilis	blue grama
Brma	Bromus marginatus	mountain brome
Brte	Bromus tectorum	cheat grass
Calam	Calamagrostis spp.	reed grass
Dagl	Dactylis glomerata	orchard grass
Elci	Elymus cinereus	basin wildrye
Elsa	Elymus salina	salina wildrye
Elgl	Elymus glaucus	blue wildrye
Hoju	Hordeum jubatum	foxtail
Hovu	Hordeum vulgare	barley
Kocr	Koeleria cristata	June grass
Orhy	Oryzopsis hymenoides	Indian ricegrass
Poa	Poa spp.	blue grass
Sihy	Sitanion hystrix	squirreltail
Stco	Stipa comata	needle and thread
GRASS LIKE		
Carex	Carex spp.	sedge
Scirp	Scirpus maritimus	bulrush
FORBS		
Anten	Antennaria spp.	pussy toes
Arco	Arnica cordifolia	heartleaf arnica
Ascle	Asclepias spp.	milkweed
Astra	Astragalus spp.	locoweed
Asco	Astragalus convallarius	narrowleaf vetch
Casti	Castilleja spp.	Indian paint brush
Ceras	Cerastium spp.	chickweed
Chdo	Chaenactis douglasii	false yarrow
Cirs	Cirsium spp.	thistle
Clco	Clematis columbiana	clematis
Coar	Convolvulus arvense	bindweed
Cora	Cordylanthus ramosus	bird's beak
Erum	Eriogonum umbellatum	buckwheat
Erysi	Erysimum spp.	wallflower
Fraga	Fragaria spp.	strawberry
Galiu	Galium spp.	bedstraw
Grsq	Grindelia squarrosa	gumweed
Hafl	Hackelia floribunda	false forget-me-not

FORBS CON'T

Hebo	Hedysarum boreale	sweet vetch
Heuch	Heuchera spp.	alum root
Hepa	Heuchera parvifolia	alum root
Ipag	Ipomopsis aggregata	scarlet gilia
Kosc	Kochia scoparia	summer cypress
Lala	Lathyrus lanzwertii	peavine
Lathy	Lathyrus spp.	peavine
Lygr	Lygodesmia grandiflora	skeleton weed
Meci	Mertensia ciliata	bluebells
Meof	Melilotus officinalis	sweet clover
Orfa	Orobanche fasciculata	broomrape
Osoc	Osmorhiza occidentalis	sweetanice
Oxytr	Oxytropis spp.	locoweed
Oxla	Oxytropis lambertii	locoweed
Penst	Penstemon spp.	penstemon
Peea	Penstemon eatonii	firecracker penstemon
Phace	Phacelia spp.	scorpion weed
Phid	Phacelia idahoensis	scorpion weed
Phau	Physaria australis	bladderpod
Saib	Salsola iberica	Russian thistle
Sedum	Sedum spp.	stonecrop
Sela	Sedum lanceolatum	stonecrop
Senec	Senecio spp.	oldman
Smst	Smilacina stellata	false soloman seal
Spco	Sphaeralcea coccinea	mallow
Stpi	Stanleya pinnata	prince's plume
Taof	Taraxacum officinale	dandelion
Thfe	Thalictrum fendleri	meadow rue
Trdu	Tragopogon dubius	oster plant
Vicia	Vicia spp.	vetch
Viola	Viola spp.	violet
Yucca	Yucca spp.	Yucca
Yuha	Yucca harrimaniae	Yucca

HALF-SHRUBS

Arfr	Artemisia frigida	fringe sagebrush
Atcu	Atriplex cuneata	mat saltbrush
Bere	Berberis repens	Oregon grape
Xasa	Xanthocephalum sarothrae (Gutierrezia sarothrae)	snake weed

SHRUBS

Amut	Amelanchier utahensis	service berry
Amal	Amelanchier alnifolia	serivce berry
Artr	Artemisia tridentata	sagebrush
Atco	Atriplex confertifolia	shadscale
Atcu	Atriplex cuneata	mat saltbush
Cela	Ceratoides lanata	winterfat
Chna	Chrysothamnus nauseosus	rubber rabbitbrush
Chvi	Chrysothamnus viscidiflorus	green rabbitbrush

SHRUBS CON'T

Epvi	Ephedra viridis	green mormon tea
Eriog	Eriogonum spp.	buckwheat
Opunt	Opuntia spp.	prickly pear
Phmo	Physocarpus monogynus	nine bark
Putr	Purshia tridentata	bitterbrush
Rimo	Ribes montegeum	currant
Rowo	Rosa woodsii	wild rose
Sambu	Sambucus spp.	elderberry
Same	Sambucus melanocarpa	elderberry
Save	Sarcobatus vermiculatus	greasewood
Syva	Symphoricarpos vaccinoides	snowberry
Syal	Symphoricarpos albus	snowberry
Tape	Tamarix pentandra	tamarix

TREES

Acgr	Acer grandidentatum	maple
Abla	Abies lasiocarpa	subapline fir
Cele	Cercocarpus ledifolius	curlleaf mountain mahogany
Cemo	Cercocarpus montanus	true mountain mahogan
Jusc	Juniperus scopulorum	rocky mountain juniper
Juos	Juniperus osteosperma	Utah juniper
Pied	Pinus edulis	pinyon pine
Pofr	Populus fremontii	cottonwood
Potr	Populus tremuloides	aspen
Psme	Pseudotsuga menziesii	Douglas fir
Salix	Salix spp.	willow
Tape	Tamarix pentandra	tamarix

The preceeding species list was complied by the SCS in June of 1982 and was submitted in its entirety. The list was compiled by Mr. George Cook and Associates "SCS report submitted".

An example of Field Notes are attached
Complete copies of Notes where submitted
For Division Review.

09/83

PARAMETER: Plant Cover	METHOD: 10-Point Frame
LOCATION: Co-op Reference Area	EXAMINER: Germain + Waldvogel

RANGE SITE: PJ - grass (Agsp)	TRANSECT NO. 3	DATE: 8/6 + 8/7 1983

COMMENTS: Record weekly phenology data in column at right side of summary.

1	2	3	4	5	6	7	8	9	10
				[illegible]	[illegible]		[illegible]		
B	B	B	R			L		L	R
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
R	R	R	R	R	B	R	R	R	R
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
				Agsp	Agsp	Agsp		Agsp	
B	L	L	R				L		R
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
			[illegible]				Agsp		Agsp
R	R	R		R	R	B		L	
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
R	L	R	R	B	R	R	R	R	R

SUMMARY

Plant Symbols	Hits	% Cover
Grasses		
Agsp	6	12
Shrubs		
[illegible]	1	2
[illegible]	3	6
Total Veg.	10	20
[illegible]	8	16
[illegible]	26	52
[illegible]	6	12
TOTAL	50	////////

Symbol For Hits

Bare Soil	B
Rock	R
Litter	L
Live Plants	Plant Symbol

Phenology Record

GRASSES
Stage 0 to 10 Leaf growth starts
Stage 10 to 20 Flower stalks appear
Stage 20 to 30 Heads full out
Stage 30 to 40 Anthesis
Stage 40 to 50 Dough
Stage 50 to 60 Hard seed
Stage 60 to 70 Dissemination starts
Stage 70 to 80 Drying

SHRUBS
Stage 0 to 10 Leaf growth starts
Stage 10 to 20 Twig growth starts
Stage 20 to 30 Flower buds appear
Stage 30 to 40 First bloom
Stage 40 to 50 Full bloom
Stage 50 to 70 Bloom over
Stage 60 to 70 Seed ripe
Stage 70 to 80 Dissemination & over

PARAMETER: Plant Density	METHOD: 1 x 50 m
LOCATION: Cocos Island	EXAMINER: [illegible]
RANGE SITE: RT (grassland)	TRANSECT NO.
DATE: 8/6 1983	
COMMENTS: [illegible]	

~~Transect~~ Plot No.	Species	DISTANCES Pt.-Quarter	5 m² NUMBERS m² Quadrat	Plot No.	Species	~~DISTANCES~~ ~~Pt.-Quarter~~	50 m² NUMBERS m² Quadrat
1	Chna		III	5	Chna	~~HHH~~ II	
	Gosa		1		Epvi	III	
	Eriog		~~HHH HH~~ I		Eriog	1	
					Pico	II	
						13	
2	Chna		II				
	Epvi		III	6	Epvi	1	
	[illegible]		~~HH HH~~ II		Gosa	~~HHH HHH~~ III	
	[illegible]		1		Pipu	1	
			18		Tamarix	1	
					Rowo	III	
3	Chna		III			19	
	Epvi		II				
	[illegible]		[illegible] ~~HHH~~	7	Chna	1	
	[illegible]		III		Eriog	~~HHH~~	
			21		Gosa	III	
					Epvi	III	
4					Pico	1	
	Epvi		III			13	
	Eriog		~~HHH HHH~~ I	8	Eriog	~~HHH HH~~ III	
	Opunt.		1		Epvi	III	
			20		Chna	1	
						17	

Appendix 9-B

United States Department of Agriculture
Soil Conservation Service
350 North 4th East
Price, Utah 84501

September 26, 1983

Mel Coonrod
Co-op Mine
P. O. Box 358
Elmo, Utah 84521

Dear Mel,

Trail Canyon Reference Area:
Pinyon-Juniper Grass Site
The production is 650 lbs herbage production for this year. The range site conditon is good.

Trail Canyon Riparian Reference Area:
The production is 2,650-3,000 lbs/acre. The condition is fair.

Bear Canyon Comparative Area:
Pinyon-Juniper Grass Site
The production is 600 lbs/acre. The range site condition is fair.

Geoarge S. Cook
Range Conservationist

CHAPTER 10

WILDLIFE RESOURCES

CONTENTS

LIST OF TABLES

Chapter 10

FISH AND WILDLIFE RESOURCES

10.1 Scope

The purpose of this report is to inventory the wildlife resources in the Co-op Permit Area and to evaluate the impact of the operation of the mine on those resources. The study includes birds, amphibians, reptiles, and mammals. Analysis entailed a review of the applicable literature, consultation with the relevant agencies, field analysis, and impact evaluation.

In sum, this study uncovers minimum impact on wildlife from continued operation of the mine. Since the Bear Canyon Mine has been worked intermittantly. since 1896, the ecosystem has already stabilized to some degree with mining.

10.2 Methodology

10.2.1 Aquatic Resources

All water within the permit area is ephemeral (Class 6). Runoff from the permit area flows into the Huntington Creek drainage. This is the only drainage which could potentially be affected by Co-op's mining activities and the potential impact is expected to be insignificant. Bear Creek may receive some groundwater from the permit area while Huntington Creek eventually receives runoff from the disturbed areas. Surveys have been conducted of both of these streams although the potential for impact is considered to be minimal.

Huntington Creek

The aquatic resource description of Bear Creek consists of a review of available information from previous surveys. Water quality determinations were conducted by certified laboratories. A biological community most likely occurs in Bear Creek on an intermittant basis. Being present during a portion of those years when runoff is exceptionally high followed by wetter than usual summer and fall precipation.

10.2.2 Terrestrial Resources

This research was designed to qualitatively evaluate the terrestrial vertebrate components in habitats which may be affected by the proposed expansion of the Bear Canyon mine. The following methodologies were used:

1. Conduct a literature review and detailed analysis of Utah Division of Wildlife Resources'(UDWR) information and initial report and wildlife plan for the Bear Canyon Mine project and geographic area of concern.

A thorough literature review was conducted. The libraries at each of the major universites in Utah were surveyed. Special emphasis was given to location of published literarure pertinent to the geographic area and habitat types in question. In addition, surrounding mine plans were reviewed for pertinent data.

Visits were also made to state and federal agencies that have jurisdiction or control over the study areas. All pertinent reports and management plans were reviewed, and appropriate personnel were questioned.

2. Contact the regulatory authorities to determine what wildlife information might be required.

The regulatory authorities were contacted by mail, phone, or personal visit to determine what wildlife information would be required.

3. Identify and cursorially inventory the terrestrial vertebrates by species for each of the habitats in the area of potential impact. Determine migratory utilization of the habitats.

Literature analysis and field observations were conducted to determine the probable and actual inhabitants of the area of potential impact and to identify habitats significant to their presence and/or persistence.

4. Categorize the status of each species and highlight those that deserve special attention because they are endangered or threatened or of economic or recreational value.

The methods and procedures essential to accomplishment of this objective involved basically two things. First, all of the species observed or known to inhabit the potential areas of impact were iden-

tified to species through Objectives 1 and 4 and listed phylogenetically in tabular form. Second, all species were categorized by (1) habitat (2) relative abundance, (3) resident species, (4)seasonal use, and/or (5) high interest species. The term "high interest species" designates those animals that require special attention by scientists and/or public management agencies because they are either endangered, threatened, protected game, or of economic or recreational value. The reasons for this high interest designation include: (1) ranges are small, thus restricting population to perhaps a few, (2) although populations may be numerically large, ranges may be small within the entire represented area, (3) irrespective of population numbers or range, little is known of the current status and in some cases information suggests that populations are declining, (4) species are sensitive to impact and may be in danger of abnormal declines, (5) species are relict or may have aesthetic or scientific value, (6) economic or recreational importance, and (7) combinations of the above.

5. Evaluate and discuss in report form the significant interactions on the terrestrial vertebrates present. High interest species are to be highlighted.

This objective is satisfied by discussions of the significant habitats, interactions, and potential results of the impacts on the terrestrial vertebrates. The data are summarily presented in tabular and mapped format to illustrate the above discussion. Impact on high interest mammalian species was rated on an impact scale. (Table 10-1)

The impact scale used rates degrees of harm from no harm = 0 to total loss of the species in the area of concern = 10.

The numerical determination for a given species was determined in the following manner: All of the information that could possibly be obtained within the scope of work for the species in question was gathered from written, field, and verbal sources. The same was true for associated pertinent information regarding the abiotic and biotic habitat as well as the proposed impact action. With this information the consequences of the action on the species in the area were evaluated and a numberical impact value from 0 to 10 was given. Pertinent points were raised, data were discussed, and the pros and cons of the proposed action were evaluated in view of the criteria applied to the Co-op Planning Unit.

This objective is satisfied by discussions of the significiant habitats, interactions, and potential results of the impacts on the terrestrial vertabrates.

The Utah Division of Wildlife Resources has determined that the permit area is of citical value for the elk and mule deer.

10.3 EXISTING WILDLIFE RESOURCES

10.3.1 Wildlife Habitat in Mine Plan Area

The area of potential impact is covered by several important habitats that are used by species considered of "high interest" to various management agencies because of economic or recreation value. There are five major vegetation habitats from a faunal standpoint: pinyon-juniper, sagebrush, conifer, grass, and riparian.

10.3.2 Wildlife

10.3.2.1 Aquatic Wildlife Habitat and Value Determination

No perennial streams run through the Co-Op Mining Company's permit area. The ephemeral stream is Bear Creek which is within the Co-Op Permit area.

Because of the stream's quality, the impact will be minimal. In addition, all drainage from disturbed areas is passed through sedimentation ponds before discharge, reducing impact potential even further.

Bear Creek is a low-quality aquatic environment of little value to the aquatic resources of the area. Even if the mines were removed, natural conditions would be stressful to aquatic life. Within the permit area all water is ephemeral (Class 6). Huntington Creek does receive runoff and/or groundwater from the permit area or at some time during the year.

10.3.2.2 Terrestrial Wildlife and Habitat and Value Determination

Literature and field data were summarized for all terrestrial vertebrates of concern. The species were categorized to determine habitat affinities, high interest species status, and potential perturbation. These results are reported in Tables 10-1 and 10-2 through 10-8 and are listed according to their various ecological classification.* All species whose ranges appear to overlap any or all of the potential area of impact are listed.

Generally, the mine plan area could potentially be inhabited by about 84 mammalian, 136 avian, 3 amphibian, and 12 reptilian species. Some of these are considered high interest species for the habitats and local area of concern. High interest wildlife are defined as all game species, any economically im-

Table 10-2

Species* List and Classification of Mammals Whose Published Ranges Overlap the Expansion Area of Co-op Mining Company

Mammal	Range					High-Interest Species
	Pinyon/Juniper	Riparian	Sagebrush	Conifer	Grasses	
Masked Shrew					UR	
Mirriam Shrew	UR	UR	UR		UR	
Dusky Shrew					UR	
Little Brown Myotis	CS	CS	CS		CS	
Fringed Myotis	US	US	US			
California Myotis	US	US	US			
Small-footed Myotis		US	US			
Silver-haired Bat					US	
Big Brown Bat					US	
Hoary Bat					US	
Townsend's Bib-eared Bat	US	US			US	
Brasilian Free-tailed Bat	US	US	US		US	
Nuttall's Cottontail				UR	UR	X
Desert Cottontail	CR	CR	CR			X
Snowshoe Hare				CR	CR	X
White-tailed Jackrabbit		UR	UR		UR	X
Black-tailed Jackrabbit	CR	CR	CR			X
Least Chipmunk	AR	AR	AR	CR	CR	
Cliff Chipmunk	CR	CR			CR	
Uinta Chipmunk	AR	AR	AR	CR	CR	
Yellow-bellied Marmot				CR	CR	
White-tailed Antelope Squirrel		AR	AR			
Uinta Ground Squirrel					CR	
Rock Squirrel					CR	
White-tailed Prairie Dog		CR				
Red Squirrel				CR		
Northern Flying Squirrel				CR	CR	
Northern Pocket Gopher		CR	CR		CR	
Great Basin Pocket Mouse		CR	CR			

* Scientific names of species are listed in Appendix 10B.

Table 10-2 (cont.)

Mammal	Range					High-Interest Species
	Pinyon/Juniper	Riparian	Sagebrush	Conifer	[illegible]	
Ord's Kangaroo Rat		CR	CR			
Western Harvest Mouse		UR	UR		U	
Deer Mouse	AR	AR	AR	AR	[illegible]	
Pinyon Mouse	CR					
Desert woodrat	CR	CR	CR			
Bushy-tailed Woodrat			CR	CR	C	
Montane Vole				CR	CR	
Sagebrush Vole		UR	UR			
Porcupine	CR			CR	C	
Coyote	CR	CR	CR	CR	C	X
Red Fox		CaR	CaR		C	X
Gray Fox		UR	UR		U	X
Black Bear				CaR	C	X
Ringtail	UR	UR	UR	UR	U	
Raccoon	Ca				Ca	
Marten				CaR		X
Ermine				UR		X
Long-tailed Weasel	CR	CR	CR	CR	C	X
Badger	CR	CR	CR	CR	C	X
Striped Skunk	CR	CR	CR	CR	C	X
Mountain Lion (Cougar)	UR	UR	UR	UR	U	X
Bobcat	CR	CR	CR	CR	C	X
Wapiti or Elk					C	X
Mule Deer	CR	CR	CR	CR	C	X

A = Abundant
C = Common
U = Uncommon
Ca = Casual or Rare
R = Permanent Resident
S = Summer Only
W = Winter Only

Table 10-4

Species* List and Classification of Amphibians Whose Published Ranges Overlap the Expansion Area of Co-op Mining Company

Amphibian	Range					High-Interest Species
	Pinyon/Juniper	Riparian	Sagebrush	Conifer	Grasses	
Western Spadefoot Toad		C	CS			
Woodhouse's Toad		C	US			
Western Leopard Frog		C	CS			

* Scientific names of species are listed in Appendix 10B.

C = Common
U = Uncommon
S = Summer Only

Table 10-5

Species* List and Classification of Reptiles Whose Published Ranges Overlap the Expansion Area Co-op Mining Company

Reptiles	Range					High-Interest Species
	Pinyon/Juniper	Riparian	Sagebrush	Conifer	Grasses	
Fence Lizard	US				US	
Sagebrush Lizard	CS	CS	CS		CS	
Mountain Short-haired Lizard	CS	CS	CS	U	U	
Rocky Mountain Rubber Boa				US		
Wandering Garter Snake	US	US	US	US	US	
Western or Yellow-bellied Racer	US	US	US		US	
Striped Whipsnake	US	US	US			
Gopher Snake	CS	CS	CS		CS	
Milk Snake	US	US	US			
Utah Mountain Kingsnake	US				US	
Night Snake		US	US			
Midget Faded Rattlesnake	CS	CS	CS		CS	

* Scientific names of species are listed in Appendix 10B.

C = Common
U = Uncommon
S = Summer Only

Table 10-5

Species* List and Classification of Reptiles Whose Published Ranges Overlap the Expansion Area of Co-op Mining Company

Reptiles	Range						
	Pinyon/Juniper	Desert Shrub	Sagebrush	Conifer-Aspen	Mixed Shrub & Grasses	Observed On Site	High-Interest Species
Fence Lizard	US				US		
Sagebrush Lizard	CS	CS	CS		CS		
Mountain Short-haired Lizard	CS	CS	CS	U	CS		
Rocky Mountain Rubber Boa				US			
Wandering Garter Snake	US	US	US	US	US		
Western or Yellow-bellied Racer	US	US	US		US		
Striped Whipsnake	US	US	US				
Gopher Snake	CS	CS	CS		CS		
Milk Snake	US	US	US				
Utah Mountain Kingsnake	US				US		
Night Snake		US	US				
Midget Faded Rattlesnake	CS	CS	CS		CS		

* Scientific names of species are listed in Appendix 10B.

C = Common
U = Uncommon
S = Summer Only

Table 10-4

Species* List and Classification of Amphibians Whose Published Ranges Overlap the Expansion Area of Co-op Mining Company

Amphibian	Range						
	Pinyon/Juniper	Desert Shrub	Sagebrush	Conifer-Aspen	Mixed Shrub & Grasses	Observed On Site	High-Interest Species
Western Spadefoot Toad		CS	CS				
Woodhouse's Toad		US	US				
Western Leopard Frog		CS	CS				

* Scientific names of species are listed in Appendix 10B.

C = Common
U = Uncommon
S = Summer Only

portant species, and any species of special aesthetic, scientific or educational significance. This included all federally listed threatened and endangered species of wildlife.

10.3.2.3 Mammals

The area of potential impact is likely to be inhabited by 84 species of mammals. The names of these animals and their habitat affinities are listed in Table 10-2. They represent 6 orders and 15 families of mammals. Twenty-five species are considered high-interest species, 14 of which are protected by state or federal code. The conifer and high elevation mountain grass areas near the Northern extreme of the permit area are used as summer range and possibly calving areas for elk, as well as summer range and fawning areas for mule dear. They are also utilized by cougar, bobcat, and possibly bear.

The low elevation mountain grass and Pinyon-Juniper habitats in the foothills just above the Mine are utilized by elk, during winter and spring. The same area is used during spring,

(In consolidation, pages 12 and 13 were eliminated).

summer, fall and, as indicated by fallen antlers, during winter by a few of the larger deer. However the major winter area for mule deer is in the pinyon-juniper and sagebrush habitats, along the lower hills and the entire foothill area. In all habitats, water is a critical resource and is possibly the limiting factor. The high interest species will be discussed individually in Section 10.4 of this report. It is doubtful that the proposed expansion will seriously impact the other species.

10.3.2.4 Birds

The Bear Canyon Mining and Reclamation Plan site was examined in September 1983 in order to finalize the current draft report. Because most of the bird species of this area are summer residents only, additional field work will not be undertaken during the winter months. (See Appendix 10--Raptor Survey)

Two species of involved birds are on the endangered species list: the bald eagle (winter resident), and the peregrine falcon (thought to be a year-round resident in southeastern Utah). However, there are no known nesting sites for the peregrine falcon in this area. Because of the suspected transient

nature of these birds, no problems are foreseen with the projected development. Further investigations were made during 1983 to confirm these assumptions. Potential areas of impact were pointed out and marked on a map. The areas designated for potential impact include: (1) Mine site location; (2) Haul road and utility corridor.

Mine Site Location

This area is approximately 10 acres and is one area where new construction will occur. It is covered primarily with pinyon and jumiper trees, sagebrush, and rabbitbrush, with spruce trees in some of the side canyons. Basically it is a high, dry, desert environment.

The more important bird species of the area are listed in Table 10-3.

Haul Road and Utility Corridors

Haul road and Utility corridors are both described as having the same general habitat as the Mine site with the addition of a narrow band of riparian habitat along Bear Creek.

Table 10-3
Birds of the Mine Site and Haul Road of the Expansion Area, Emery County, Utah

Name	Season of Occupancy	Status
Turkey vulture	spring, summer, fall	uncommon
Red-tailed hawk	all year	common
Swainson's hawk	spring, summer, fall	uncommon
Ferruginous hawk	spring, summer, fall	uncommon
Golden eagle	all year	uncommon
Bald eagle	winter	rare
Marsh hawk	all year	uncommon
Prairie falcon	all year	common
Peregrine falcon	all year	rare
Sparrow hawk	all year	common
Chukar	all year	unknown
Mourning dove	spring, summer	common
Great-horned owl	all year	uncommon
Poor-will	spring, summer	common
Common night hawk	spring, summer	common
Black-chinned hummingbird	spring, summer	common
Broad-tailed hummingbird	spring, summer	common
Common flicker	all year	common
Hairy woodpecker	all year	uncommon
Downy woodpecker	all year	uncommon
Western kingbird	spring, summer	common
Ash-throated flycatcher	spring, summer	common
Say's phoebe	spring, summer	common
Gray flycatcher	spring, summer	uncommon
Violet-green swallow	spring, summer	common
Horned lark	all year	common
Black-billed magpie	all year	common
Raven	all year	common
Crow	spring, fall, winter	common
Pinon jay	all year	common
Mountain chickadee	all year	common
Plain titmouse	all year	uncommon
Bushtit	all year	uncommon
Bewick's wren	spring, summer	uncommon
Robin	all year	common
Mountain bluebird	spring, summer, fall	uncommon
Blue-gray gnatcatcher	spring, summer	uncommon
Cedar waxwing	all year	uncommon
Loggerhead shrike	spring, summer	uncommon
Starling	spring, summer, fall	uncommon
Gray vireo	spring, summer	uncommon
Solitary vireo	spring, summer	uncommon
House finch	all year	common
Pine siskin	all year	common
Lark sparrow	spring, summer	common
Chipping sparrow	spring, summer	common
Sage grouse	all year	uncommon
Pigmy owl	all year	uncommon
Long-eared owl	all year	uncommon
Saw-whet owl	all year	uncommon
White-throated swift	spring, summer	uncommon
Cassin's kingbird	spring, summer	uncommon
Western flycatcher	spring, summer	uncommon
Scrub jay	all year	uncommon
White breasted nuthatch	all year	uncommon
Western bluebird	all year	uncommon
Townsend's solitaire	all year	uncommon
Black-throated gray warbler	spring, summer	common
Scott's oriole	spring, summer	uncommon
Rufous-sided towhee	all year	uncommon
Brewer's sparrow	spring, summer, fall	uncommon
Black-chinned sparrow	spring, summer	uncommon

10.3.2.5 Reptiles and Amphibians

The material used in this portion of the report was derived from literature and a discussion with Dr. W. W. Tanner (retired) an internationally known herpetologist specializing in the reptiles and amphibians of Utah.

Increasing elevation rapidly reduces the number and kind of reptiles and amphibians. In Utah, the more northern latitude reduces numbers of reptiles and amphibians in much the same way as does the increase in elevation.

The geographical and associated climatic factors have eliminated most desert species, leaving species that are adapted either to mountain habitats or montane type habitats developed in the more northern areas. Thus, the reptiles and amphibians of Utah, and particularly those inhabiting the areas under the consideration, have arrived in Utah by means of dispersal lanes coming from the northeast and the southeast. With few exceptions, the species listed have wide distribution and are versatile in their adaptive abilities.

Literature pertaining to the amphibians and reptiles is extensive, but much of it refers to species occuring in the desert areas and has only limited reference to forms inhabiting high elevations in Utah. Most of the publications dealing with species lists for the state are old.*

The most up-to-date listing for the area under consideration may well be a checklist of Utah amphibians and reptiles (Tanner, 1975), and Utah Division Publication No. 78-16 (Dalton, 1978) which references a contiguous and similar geographic area.**

* V. Tanner, Amphibians, 1931; Woodbury, Reptiles, 1931; and Pack, Snakes, 1930.

** Other recent literature pertinent to this report are:

Schmidt (1953); Stebbins (1954 and 1966); W. Tanner (1953, 1957a and b, 1966-with Banta, 1969-with Morris, and 1972-with Fisher and Willis); and Woodbury (1952).

Reptiles

Based on a review of the literature, it was determined that probably 12 species of reptiles (Table 10-5) occupy the expansion area; this area is considered to be a substantial value habitat for all species. All reptiles have some protection under the Utah code, but since the species listed are all widespread throughout similar habitats in Utah, none are treated as high interest species and, therefore, are not individually discussed.

Amphibians

Based on the literature review, it was determined that probably three species of amphibians (Table 10-4) inhabit the proposed area of concern which provides substantial value habitat for the three species listed. All amphibians are legally protected in Utah, but since the species listed are all widespread throughout similar habitats in Utah, none are treated as high interest species, and therefore, are not individually discussed.

10.3.3 Species of Special Significance

10.3.3.1 Threatened and Endangered Species

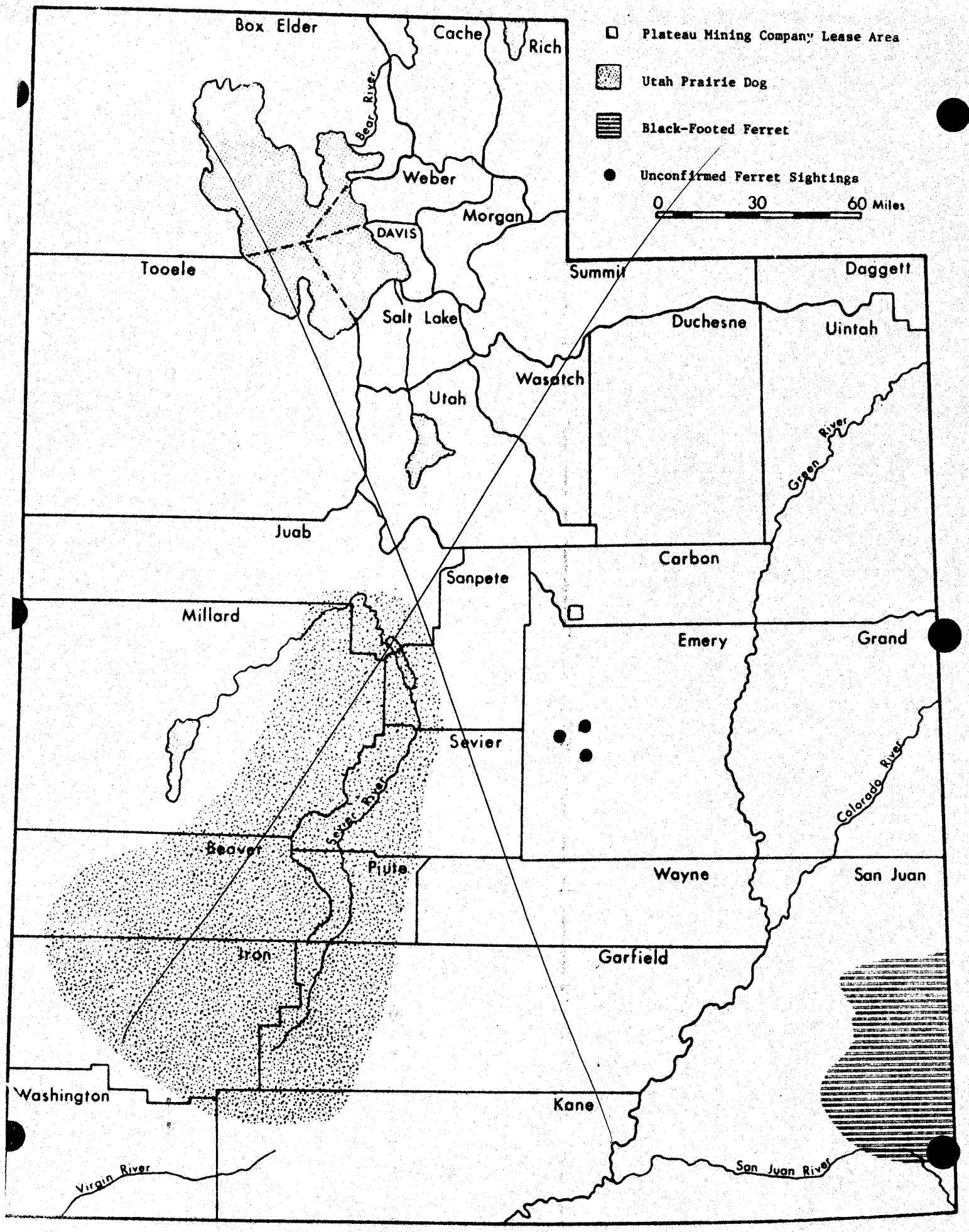


FIGURE 10-5. Endangered Mammalian Species in Relation to Proposed Impact Area

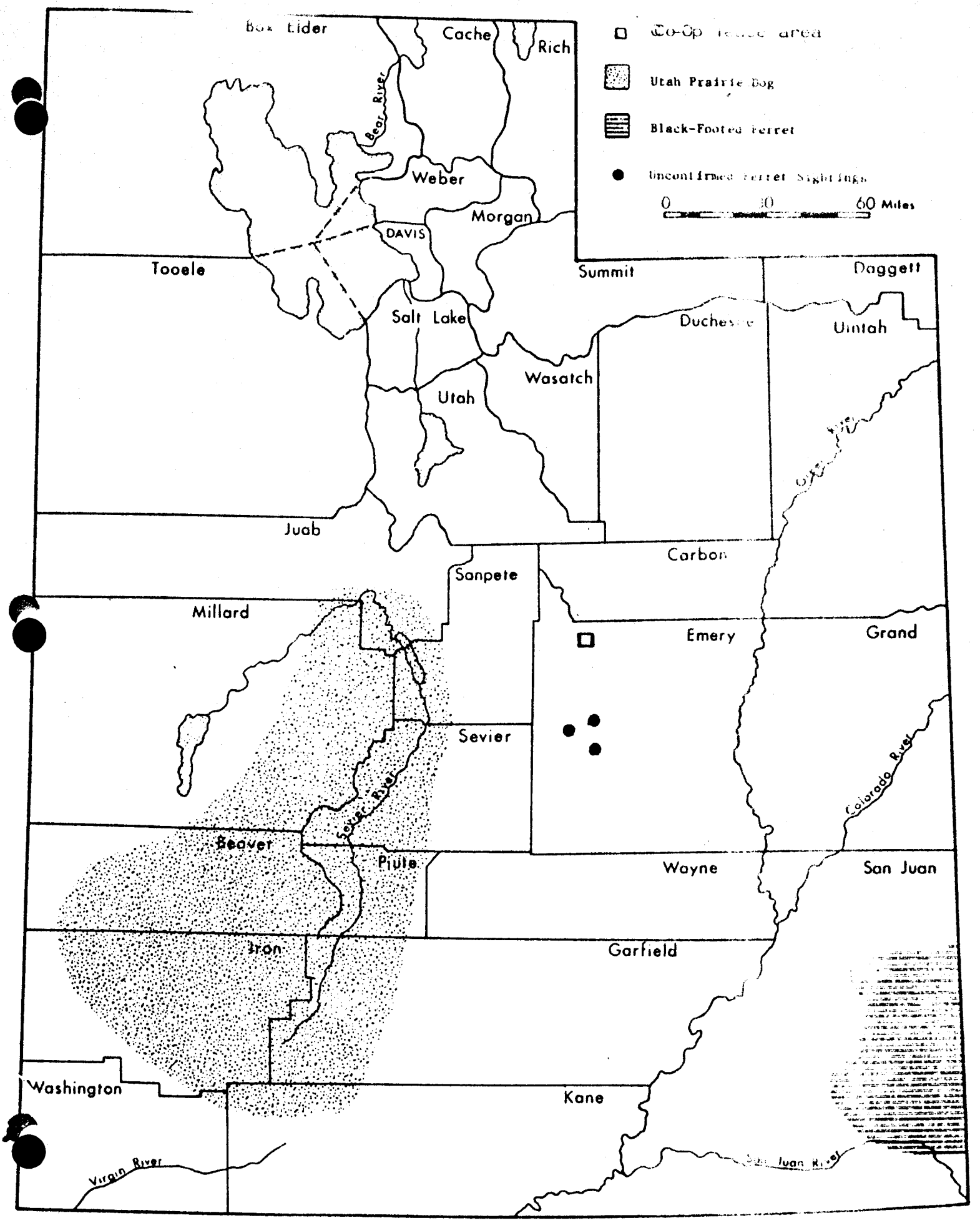


FIGURE 10-5. Endangered Mammalian Species in Relation to Proposed Impact Area

There are no endangered or threatened species of mammals in the mine plan area, nor are there any in proximity close enough to be considered (Figure 10-5). Co-Op is committed to notify the Division in the event any T & E species were observed on the permit area, as well as any critical habitat.
Official U.S. Fish and Wildlife Service Section 7 opinions relating to the aquatic resources of Huntington and Eccles Canyon drainages have indicated that no threatened or endangered species of fish or other aquatic organisms have been found in waters upstream of the lowest 2 or 3 mi of the Price or San Rafael rivers. The organisms of Trail Creek, as presently known, are all common and widely distributed throughout streams of Utah. The aquatic organisms of Bear Creek have representatives of several taxa limited to low quality environs, but none, as far as is presently known, are rare in the inter-mountain region.

10.3.3.2 Raptors

Two species of endangered raptors may be found in the mine plan area. These are the bald eagle and peregrine falcon. There are no known roosting trees or nesting sites within the permit area according to a survey conducted by the Raptor Biologist from the U.S. Fish and Wildlife Service.

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Additional studies will be made during the raptor breeding seasons in the year to come to confirm the absence of raptor nesting sites in the Permit area.

10.4 EXPECTED IMPACTS OF MINING OPERATIONS ON FISH AND WILDLIFE

10.4.1 Aquatic Wildlife

The mine is an existing mine and as such should have no additional impact on Bear Creek, which is furthermore of little value to the aquatic sources of the area. Natural conditions would be stressful to the aquatic life even if existing mining activities were removed.

Trail Creek is a marginal quality stream and as such should be protected. The only foreseeable impact from the Co-op Mine project would be from subsidence of source aquifers causing a reduction in the total flow. There are no new planned surface disturbances adjacent to Trail Creek. Minimal disturbance will occur at the Bear Canyon Mine area, which is within the drainage of Huntington Creek. Since the creek is a considerable distance from the mine and since the areas of disturbance will be small, the impact will be insignificant. Subsidence, if it should occur,

would have only a minor impact, and then not on Huntington Creek itself.

10.4.2 Terrestrial Wildlife

Mammals

Only those mammals of major concern to management agencies are individually discussed.

Mule Deer

Mule deer on the Bear Canyon Mine and the proposed expansion area are considered part ot herd unit 33 by UDWR. Historically, through 1977, this herd experienced the same general fluctuations as the other herd units of the state. Populations decreased in the early 1970's primarily due to severe climatic conditions, but took a general upswing through the summer of 1977. Then there were three consecutive years of decline wherein the deer were forced to the extreme lower limits of their winter range by abnormally deep and long-lasting snow.

The animals utilize the entire area of potential impact but seasonally concentrate in, and more

heavily utilize, specific habitat types. The high elevation mountain brush-grass and conifer-aspen habitats near the Northern edge of the permit area are used for summer range and fawning. The low altitude mountain brush, mixed desert shrub, and pinyon-juniper habitats are used as winter range during normal winters; during excessive snow the deer move off the impact area and go east well below the Permit Area. The browse in the wintering habitats in the impact area is in relatively good condition and can facilitate overwintering of deer in a normal year.

Cougar

The entire Bear Canyon Mine and Haul Road area provide yearlong habitat for cougar. Cougars could range throughout the area, but their movements are dictated by migration patterns, human disturbance, and availability of their primary food source, mule deer. Since cougars are not abundant and are known to be secretive, avoidance will be practiced when the females are accompanied by young learning to hunt and survive.

This period in the life cycle of the cougar, however, is difficult to determine since they are know to re-

produce yearround. If cougar populations in the area of potential impact were high, this would be of major concern, but, since numbers are low and ranges extensive compared to the area of potential impact, the cougars will continue to avoid human activity areas and there will be little impact on the overall cougar population.

Bobcat

The mine and proposed expansion and adjacent areas provide habitats for bobcats. Although little is known about the Utah bobcat, one sensitive period would be late February when parturition occurs. May and June would also be a sensitive period because young bobcats, when learning to hunt, are not as secretive as the cougar, making them less likely to avoid high human disturbance areas during these months. However, since this is an ongoing mining operation, impact on bobcats should be unchanged.

Black Bear

Only the breakout and ventilation shaft portion of the mine and proposed lease expansion areas provide potential habitat for black bear, which are neither

abundant nor active yearround. Sensitive periods in the life cycle of the black bear are February and March when the cubs are born and during the early summer when they accompany their mother on initial foraging expeditions. Since the parturition occurs within the winter den, disturbance in the black bear habitat will be limited and there will be little impact during this sensitive period. The same is true of the initial foraging forays.

Mountain and Desert Cottontails

The entire mine and proposed lease expansion areas provide substantial value, yearlong habitats for cottontail rabbits. The young are born between April and July, which is considered a sensitive period, but the proposed actions will in all probability not seriously alter reproductive potential of the populations. Hunting pressure most likely will not increase nor will illegal kill, however, this would not matter since the hunted rabbit populations are more healthy and stable than nonhunted populations. Subsidence could potentially create a problem, but since it is limited to relatively small areas at a time, little overall impact will occur. It should be noted that disturbed vegetation

leading to succession (if it occurs) would enhance reproductive potential of cottontail rabbits.

Snowshoe Hare

The snowshoe hare is present in and dependent upon the mixed conifer-aspen vegetation habitat year-round. This habitat type is limited in the mine and Permit area and the proposed actions will do little to harm the habitat type and the dependent hare populations. Although the sensitive period for reproduction is from April 1 to August 15, there will be no serious long term impact on the snowshoe hare and there will be little change in population. Subsidence will not harm the aboveground dweller as it potentially could the subterranean inhabitants. Hunting will be the most influential activity of man upon snowshoe hares but there should not be much difference from prior years and no longterm impact.

Furbearers

Limited portions of the proposed mine lease and adjacent areas provide substantial value habitats for a few species categorized bymanagement agencies as furbearers: ermine, long-tailed weasel, badger, and