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United States Department of the Interior

GEOLOGICAL SURVEY

Conservation Division
8422 Federal Building
Salt Lake City, Utah 84138

December 11, 1975

Memorandum

To: Participants, onsite meeting re the proposed Belina No. 1 Underground Mine, December 11, 1975, Clear Creek, Utah

From: Donald C. Alvord, District Geologist
/s

Subject: Assesment of the potential geologic impact of the Belina No. 1 Underground Mine, coal lease holds U-020305, U-044076, and U-017354, Carbon and Emery Counties, Utah

Belina #I-fall 76 | 20-25 year mine plan
#II-fall 77 | IN-OUT Retreat

This memorandum outlines factors relavent to an assessment of the potential for geologic hazards resulting from the proposed action. It has been prepared from information gathered during onsite inspections, examination of operator furnished maps and drill logs, conversations with colleagues, and from conventional office analysis of published and unpublished materials.

Carbon Co
Wants
Water diverted
into Codamoze

In the area of the proposed action:

Utah #2
6000X 1415,000 long
100mm
reserves

1) the only rocks likely to be affected by establishment and successful completions of the Belina No. 1 Mine projection are those of the Blackhawk and adjacent formations, which rocks are described on figure 1;

2) only two coal seams are of commercial interest at this time, these occur in the lower third of the Blackhawk Formation and are locally named the Upper and Lower O'Connor Seams;

5 entries
upper-low
O'Connor
2mm./TPY via RR

3) the seam mined at the Winter Quarters Mines area (Figs. 2 and 3) is evidentally the same as the Upper O'Connor Sea m, Spieker (p. 95, 1931) considered the Winters Quarters Seam correlative with the more regionally known Castlegate "A" Seam;

Conveyor
eventually
from mine
to Eccles
late 1977

4) rock strata dip gently westward with slopes of from 5 to 10 percent;

5) north trending high angle normal faults cut the rocks with known displacements of as much as 300 feet, two such faults form the east and west boundaries of the Connelsville reserve block (fig. 2);

Settling
ponds for
surface
facilities runoff.

6) twelve drill holes indicate that the Upper O'Connor Seam ranges in thickness from 7.1 to 21 feet, averages 16.3 feet ($\sigma_{N-1} = 4.3$ feet), and dips from 6 to 10 percent westerly;

10-1200'
overburden
avg-6-700'

7) ten drill holes indicated that the Lower O'Connor Seam ranges in thickness from 7.7 to 25 feet, averages 15 feet ($\sigma_{N-1} = 5.1$ feet);

to 200 people
1.80

8) ten dril holes indicate separation between the two commercial seams ranges from 51 to 125 feet and averages 80 feet ($\sigma_{N-1} = 26.6$ feet);

Screen & crush no separation plant / New load-out facilities

9) depth of rock cover over the Upper O'Connor Seam ranges from zero on the north and northeast to about 1,200 feet at the southwestern margins of the reserve block;

10) about 90 percent of the Upper O'Connor reserve or 1,442 acres, occurs at depths of 1,000 feet or less (Table 1);

11) about 80 percent of 1,335 acres of the Lower O'Connor reserve occurs at depths of 1,000 feet or less (Table 2);

12) a total of 34 percent or 1,116 acres of the Upper and Lower O'Connor reserves occur under 500 feet or less of rock cover;

13) from surface facilities accessed and sited on fee lands, the proposed action will drift mine by modified room and pillar, coal of the Upper O'Connor Seam; up to 12 feet of coal will be taken with panel advance;

14) successful completion of the action would win the recoverable coal from the Upper O'Connor Seam from an area underlying about 220 acres of fee lands and 1,390 acres or 29 percent of the subject federal tracts;

15) reserves in the Upper O'Connor Seam average about 16 feet in thickness and aggregate 6,350,000 tons private coal and 40,000,000 tons federal coal;

16) market permitting, reserves of the Lower O'Connor Seam will be mined (Belina No. 2 Mine) via entries sited below and near the Belina No. 1 main entries; entries, rooms and pillars of the Belina No. 2 Mine will subpose those of the No. 1 Mine in as much as possible;

17) successful completion of the Belina No. 2 Mine would win the recoverable coal from the Lower O'Connor Seam from an area underlying about 235 acres of fee lands and 1,405 acres or 29 percent of the subject federal leaseholds;

18) reserves in the Lower O'Connor Seam average about 15 feet in thickness and aggregate about 6,350,000 tons private coal and 37,935,000 tons federal coal;

19) successful completion of the Belina No. 1 and No. 2 mine projections would probably result in a number of superposed panel areas up to several tens of acres each within which areas [illegible] a cummulative thickness of from 20 to 30 feet of coal has been almost totally removed; panel barriers involving up to several acres each of in place coal would form continous column buttresses between the mined out panels;

20) as indicated by surface seeps, ground water must at least locally saturate the rocks immediately overlying the Upper and Lower O'Connor Seams.

Concerning the Winter Quarters Mines area (figure 3):

1) mining at the Winter Quarters area was initiated in 1878 and finally terminated in the early 1940's; practically all of the production, however, some 12.5 million tons, was obtained prior to the 1930's;

2) figure 3, based in part upon a 1:4,000 scale mine map up dated through January 1, 1927, outlines (in red) the principal panel areas indicated mined out, as well as the faults (blue) and igneous dikes (green) that had been encountered at working levels by that date; extensive entry systems, service ways, and numerous smaller room and pillar areas are not represented;

3) a general area of 1,325 acres or about two square miles of lands were undermined, of this area at least 695 acres are shown as mined out panels, one single such panel aggregating 250 acres;

4) normal displacements along the east-west faults attained maximums of 90 feet north side down on fault "B" and 45 feet south side down on fault "A", recorded displacements along all other recognized faults at mine levels range from 3 to 12 feet;

5) limited data indicates that the Winter Quarters Seam ranged in thickness from about 6 to 20 feet; depth of rock cover was very comparable to that of the Belina No. 1 Mine projection, approaching 500 to 800 feet maxima beneath the ridges along the eastern half of the area and increasing westward to locally exceed 1,000 feet along the western margins;

6) faulting was a major factor in the mining plan, necessitating three separate main entry systems south going from Winter Quarters Canyon, two superposed levels at some localities, and determining mining panel limits at many localities;

7) igneous dikes and water were only minor nuisances;

8) subsidence features on the lower hill slopes in the vicinity of entry areas are minor and generally subtile to ambiguous with probable surface generated failures (slides and discussion);

9) at ground level viewing subsidence features (effects) of the Winter Quarters mining upon the upper reaches of the hill surfaces are subtile to ambiguous with probable surface generated failures (slides and discussion);

10) no features possibly attributable to mine subsidence that are of potential danger to human or animal life or are deletarious to the present land uses were noted during the course of two seperate onsite examinations

Conclusions regarding potential geologic degradation effects and hazards of the proposed Belina No. 1 Underground Mine:

1) because most of the mining will be done under 1,000 feet or less of rock cover, ground control at mine levels during the life of the mine may present few problems;

2) on the other hand, undetected faulting within the area could present cost significant problems to mine development; in view of the proven minability of the Winter Quarters Mines ground, however, it would appear that any faulting encountered would likely be crossed without undue hazard or expense;

3) a quantitative analysis of the potential subsidence has not been made, however, owing to the probability of a two seam operation (Belina No. 2 Mine), transfer of ground movement to surface most certainly will exceed that of the Winter Quarters area;

4) owing to the relative thin rock cover subsidence features similar to those observed at other mines in bedded formations are inevitable; these include tubular or funnel shaped holes of collaps down to working levels under very near surface conditions in the vicinity of entries and cut outs, general surface subsidence over mined out panels accompanied by compression and rock arching as the result of ground movement from over adjacent panel barriers laterally and downward into the mined ground, and tension fracturing over panel barriers as the result of draw movement from the barriers down into the mined out panels;

5) I tentatively predict that presheared rock within the natural fault boundaries of the Connelville reserve block will absorb and(or) deflect into the fault zones lateral failure and movement following up the angle of draw and away from the areas of caving grothds serving to confine subsidence failure to the area actually undermined;

6) the general 5 to 10 percent slope westward of the rocks indicates that some amount of the ground water occuring above and within the target seams that presently makes its way into Boardinghouse and Eccles Canyons will be diverted by the mine workings westward towards the canyons tributary to Huntington Canyon;

7) accessing and siting the mine plant and main entries presents environmental impacts such as accelerated erosion and sedimentation resulting from vegetal and soil destruction, spoil (mine dump) failures, overflow of culverts owing to stoppage, collapse, or undersize, slumping and sliding of poorly drained constructed bedrock and fill plant site terraces, etc., but these impacts are routine to construction and mining operations within the region and are unlikely to induce geologic hazards or environmental degradation that can not be contained or adequately moderated at reasonable costs.

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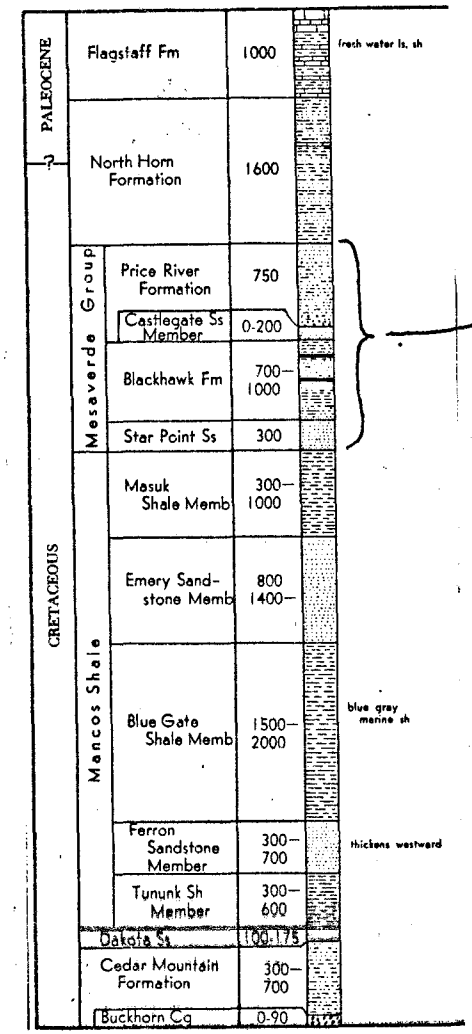

Figure 1. - Geologic setting of the proposed Belina No. 1 Underground Mine area.

The proposed action will be sited in and directly impact only rocks of the Mesaverde Group of Upper Cretaceous Age, the only stratified rocks above stream in the subject Federal tracts. In this area these rocks are subdivided as follows: 1) the Price River Formation, about 1000 feet thick, chiefly coarse grained sandstones and conglomeratic sandstones with a few thin intervals of shale in the upper half; 2) the Blackhawk Formation, about 1000 feet thick, chiefly units of fine to medium grained quartz wacke sandstones interstratified with near equal proportions of silty to sandy shale units, contains several coal seams including, in its lower half, the commercial seams of the area; and 3) the Star Point Sandstone (Formation), as much as 1000 feet thick, chiefly units of fine to medium grained quartz wacke sandstones (individually as much as 150 feet thick) intertongued with units of Marine shales (individually as much as 100 feet or greater in thickness), correlative with the Mancos Shale of Lower and Upper Cretaceous Age. In the hand specimen, at least, there appears to be no objective way to determine sandstones of the Blackhawk Formation from sandstones of the Star Point. Layers of fine grained calcareous sandstones are attributed to portions of the Blackhawk Formation (Spieker, 1931, p. 29) but otherwise no mention is made of the presence of limestones within the Mesaverde sequence. Shell rich layers of fresh water limestone, however, are described within the overlying Wasatch (Eocene) Formation.

The leasehold area lies along the western limb of the Pleasant Valley anticline, a poorly defined asymmetric flexure having its surface expression confused by a system of mostly north trending high angle faults that approximately parallel the axial trace of the anticline (Spieker, 1931, Plate 31). Throughout most of the area the rocks dip gently westward with slopes of from 5 to 8 percent. These rocks are cut by high angle normal faults that evidently are northerly extensions of the Joes Valley and Valentine fault zones (Plate 31, Spieker, 1931). Recent drilling by Sanders Associates, Inc. has extended or modified the traces of some of these earlier noted faults and has also detected normal displacements of as much as 300 feet (Connelville and O'Connor Faults). Although reportedly the zones of disrupted rocks associated with these faults are narrow (a few feet, more or less), their magnitudes of displacement form abrupt barriers to mine plan projections.

Table 1. -- Seam acres, depth of cover, and gross reserves of Upper O'Connor Seam, between Connelville and O'Connor Faults and within projection of proposed Belina No. 1 Underground Mine (fig. 1).

Land Status	Federal Tract Acres 1/	Acres in Mine Projection	Percent of Federal Tract	Depth of Overburden (in feet) overlaying mine projection (in acres) 1/			Expected Seam Thickness	Total Reserves (tons)
				0 - 500	500 - 1,000	1,000 - 2,000		
Private	NA	220.4	NA	210.1	10.3	none	16 2/	6,348,000
U-017354	1,028.47	643.4	62.6	61.4	459.7	122.2	16	18,530,000
U-020305	1,439.40	642.8	44.6	332.3	279.5	31.	16	18,513,000
U-044076	2,367.82	103.9	4.4	none	88.4	15.5	16	2,992,000
Private	NA	220.4	NA	210.1	10.3	none		6,348,000
Federal	4,835.69	1390.1	28.7	393.7	827.6	168.7		40,035,000

1/ Calculated by electric graphic calculator using 1:6,000 scale map with 20 foot contours.

2/ Rounded average calculated from 13 drill holes: $N=13$, $\bar{X}=16.3$ feet, $\sigma_{N-1}=4.1$ feet.

3/ All reserve classes combined.

Table 2. -- Seam area, depth of cover, and gross reserves of Lower O'Connor Seam, between Connelville and O'Connor Faults and within projection of proposed Belina No. 2 Underground Mine (fig. 1).

Land Status	Federal Tract Acres 1/	Acres in Mine Projection	Percent of Federal Tract	Depth of overburden (feet) overlaying mine projection (in acres) 1/ 0 - 500	500 - 1,000	1,000 - 2,000	Expected Seam Thickness 2/	Total 3/ Reserves (tons)
Private	NA	235.3	NA	203.8	31.5	none	15.	6,353,000
U-017354	1,028.47	648.5	63.1	36.7	394.3	217.5	15.	17,510,000
U-020305	1,439.40	657.7	45.7	271.5	319.1	67.1	15.	17,758,000
U-044076	2,367.82	98.7	4.2	none	78.6	20.1	15.	2,665,000
Private	NA	235.3	NA	203.8	31.5	none		6,353,000
Federal	4,835.69	1404.9	29.1	308.2	792.0	304.7		37,933,000

1/ Calculated by electric graphic calculator using 1:6,000 scale map with 20 foot contours.

2/ Rounded average calculated from 10 drill holes: $N=10$, $X=15.3$ feet, $\sigma_{N-1} = 5.1$ feet.

3/ All reserve classes combined.

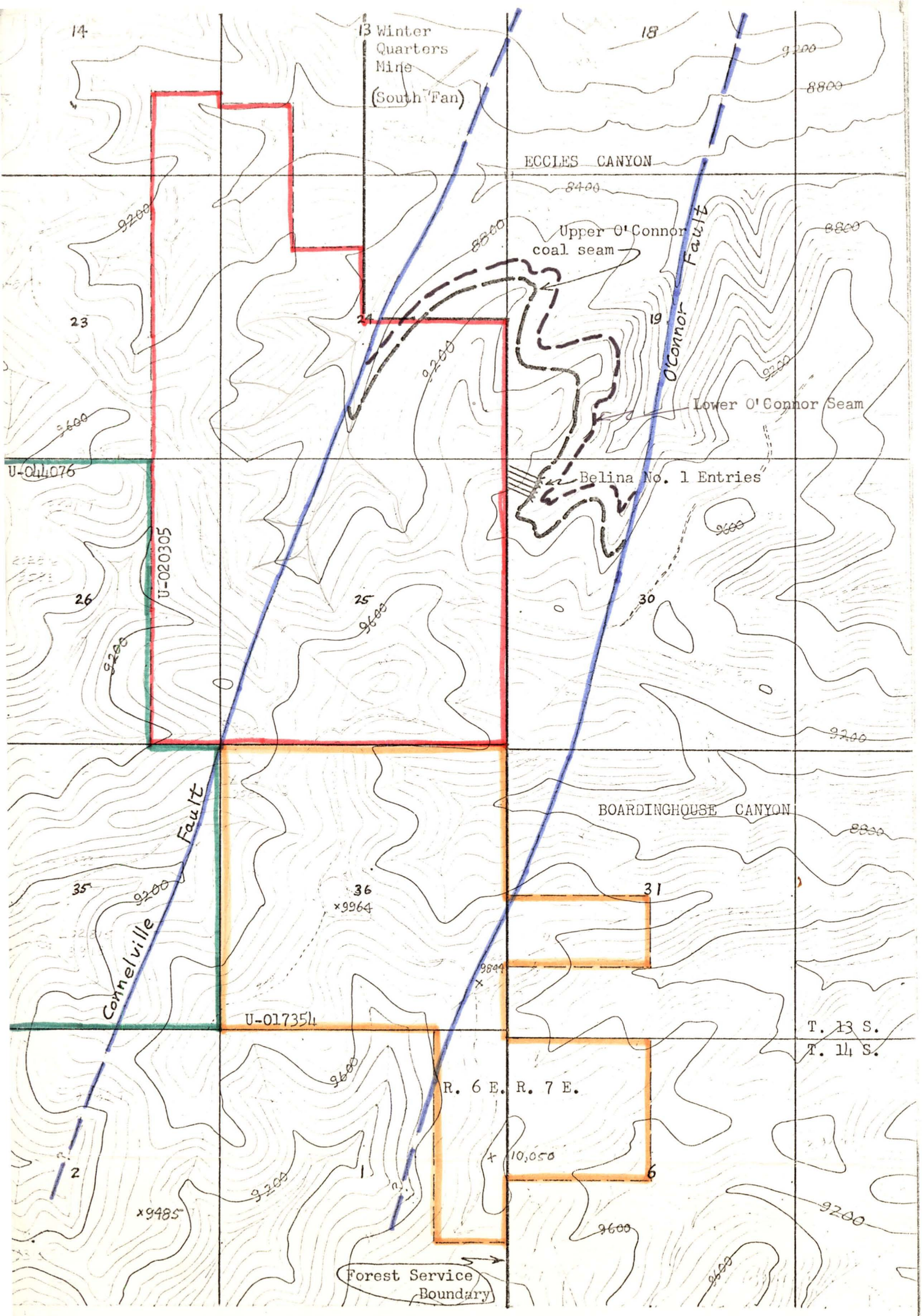

Figure 2 -- Area of proposed Belina No. 1 underground mine, Clear Creek Mining District, Carbon and Emery Counties, Utah

U-017354
U-020305
U-044076

Scales: Contour interval -- 80 feet
1 inch = 2,000 feet

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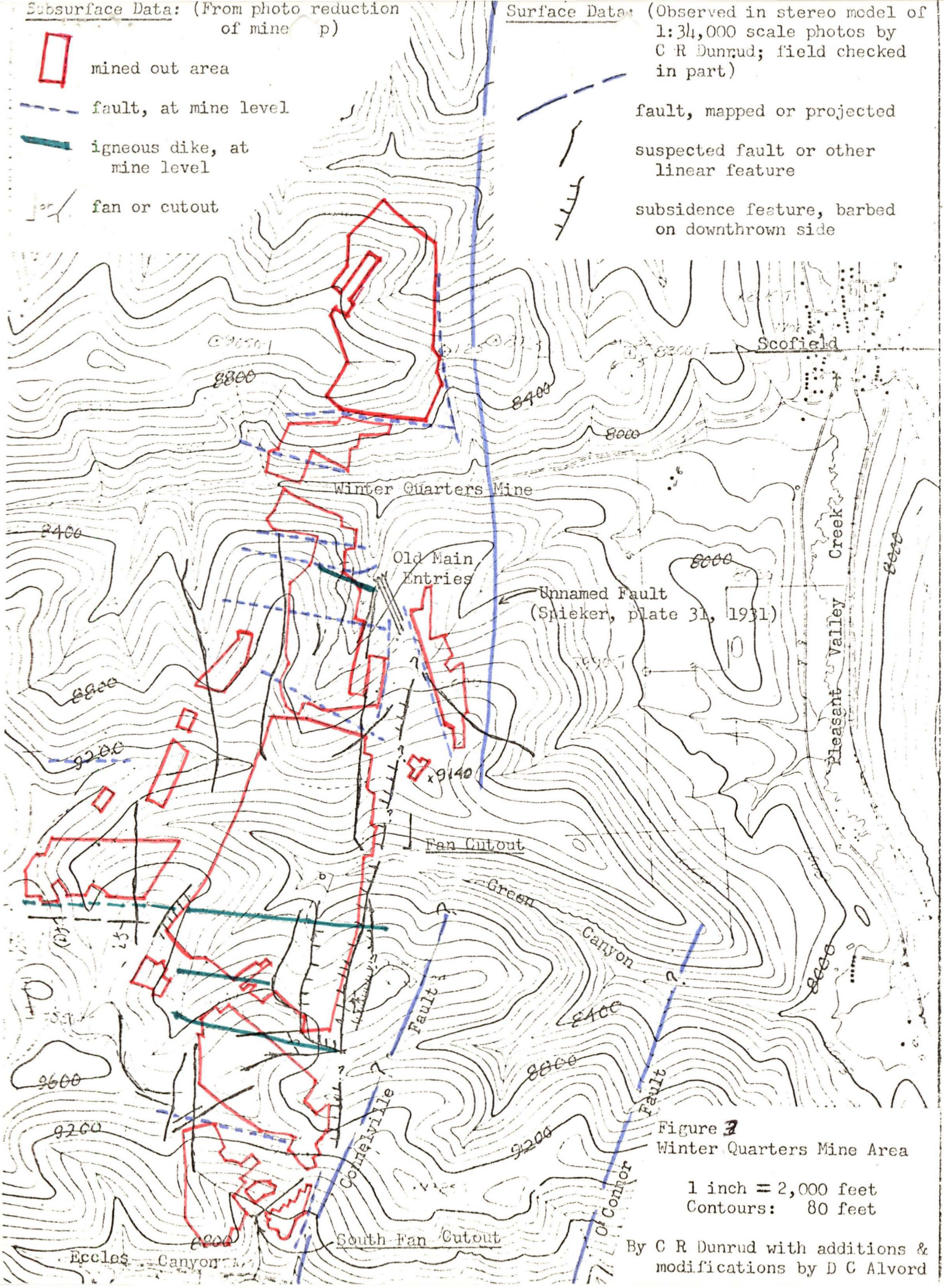

Figure 3
Winter Quarters Mine Area

1 inch = 2,000 feet
Contours: 80 feet

By C R Dunrud with additions & modifications by D C Alvord