0010

ACT/007/006#2

STATE OF UTAH
NATURAL RESOURCES
Oil, Gas & Mining

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See P 11: Recommendations LAB 7-16

June 25, 1987

TO: Coal File

FROM: Rick Smith, Geologist RVS
Tom Munson, Reclamation Hydrologist jh for TM
Kathy Mutz, Reclamation Biologist KM
Pamela Grubaugh-Littig, Reclamation Engineer pgl

RE: Review of Proposed Mine Development and Potential Subsidence Impacts, New Lands Property, Plateau Mining Company, Folder No. 2, ACT/007/006, Carbon County, Utah

The applicant proposes to conduct longwall mining in the Wattis seam and Third seam. Each seam will be extracted to an average height of seven (7) feet for a total mined thickness of fourteen (14) feet. Mining will be initiated in the Wattis seam where six (6) longwall panels will be developed between 1988 and 1990. Two longwall panels will be subsequently developed in the underlying Third seam during late 1990 through early 1992.

Geology

Overburden thickness ranges from approximately 200 to 1,100 feet above projected Wattis seam development (Map 23). Stratigraphic units overlying projected panel development include, in descending order, The Price River Formation, Castlegate Sandstone, and Blackhawk Formation. The applicant characterizes overburden lithology as consisting of 50 percent sandstone and 50 percent mudstone.

Four faults have been identified within the area of proposed mining. Three of the faults trend northerly and occur along the western margin of panel development. Displacements for the northerly trending faults are less than 10 feet. The fourth fault trends approximately east-west and bisects the northernmost

proposed longwall panel in the Wattis seam and Third seam. Fault displacement is identified to be from zero to four feet. Faults and fractures that trend northerly are considered to be "open" and actively transmit water, whereas the east-west fault is presumed to be "closed".

Hydrology

The North Fork of the Right Fork (NFRF) of Miller Creek qualifies as a perennial stream. Single and double seam mining are projected to occur beneath approximately 2,000 and 1,500 foot segments of the NFRF of Miller Creek, respectively. Flow averages between .5 and 1.0 cfs as measured at monitoring station ST-1, below the area of proposed mining.

Thirteen springs, having a combined flow of 46 gpm, occur within the projected area of subsidence for the New Lands application. Seven springs are associated with the Castlegate Sandstone, one spring with the Blackhawk Formation, and the remaining five springs with the Price River Formation.

Topography

Over 50 percent of the area encompassed by proposed longwall panels within the New Lands property are oriented and located beneath rugged topography where slopes range from 30 to 60 degrees. For panels located beneath the NFRF Miller Creek, overburden thickness values are given below.

Seam(s)	Development Dates	Overburden Thickness (ft)
Wattis: Third	8/88 - 2/89; 11/90 - 6/91	750 - 825
Wattis: Third	2/89 - 8/89; 6/91 - 1/92	550 - 750
Wattis	8/89 - 11/89	300 - 550
Wattis	11/89 - 2/90	200

Applicant's Geotechnical Analysis

The applicant integrates site-specific data with information derived from studies conducted locally (East Mountain), regionally (New Mexico), and in Europe (Donets Basin) to develop a framework for assessing potential mining-induced subsidence impacts. This derived methodology was applied to establish a plan for mining coal resources within the New Lands property.

The applicant's methodology for assessing potential subsidence impacts consists of subdividing the overburden above mined areas into three zones that are characterized by different types of rock failure. The vertical extent to which these zones propagate is presumed to be a function of overburden lithology, mining methods, and extraction thickness. The three zones are characterized, in ascending order, as follows.

Zone 1: Immediate roof, highly stressed and free to collapse.

Zone 2: Rocks will deform and fracture, but maintain their lateral continuity because of lateral confinement. Fracturing is associated with lateral expansion resisted by the sidewalls of the excavations.

Zone 3: Adjacent to the surface. Open cracks may develop at the surface due to the lack of lateral confinement. Open cracks are believed to cease at a depth of 45 feet due to lateral confinement and transition to Zone 2.

The applicant utilizes data derived from the Donets Basin to infer the relationship between extracted coal thickness and maximum upward propagation of Zone 1. Moreover, the applicant assumes a thickness for Zone 2 based upon the average occurrence of shales penetrated by two boreholes. The vertical extent of Zone 3 is derived from a study conducted in New Mexico. Listed below are the applicant's maximum Zone 1, 2, and 3 values for single-and double-seam mining.

	Single Seam (ft)	Double Seam (ft)
Zone 1	315	395
Zone 2	40	40
Zone 3	45	45
Total	400	480

The values derived above are used by the applicant to restrict the location of longwall panels. Accordingly, single and double seam longwall panels are located beneath a minimum of 400 and 480 feet of overburden, respectively.

The applicant identifies certain mining-induced subsidence impacts that could occur as a result of proposed development within the New Lands property. Specifically, the development of surface cracks at final mining boundaries where there is less than 800 feet of overburden, at the base of certain springs, and along portions of the channel of NFRF Miller Creek. The applicant also recognizes the potential for increasing permeability along the northerly trending faults. Accordingly, surface flow from springs and along NFRF Miller Creek may be diverted into surface cracks.

Review of Applicant's Geotechnical Analysis

The applicant's analysis of potential mining-induced subsidence impacts may be somewhat optimistic upon close inspection of the premises used to develop the zonation methodology for restricting longwall panel locations.

Zone 1 - The applicant assumes a "similarity of strata conditions and subsidence characteristics between Donet and Price coal fields (Fejes , 1985)" to assign a Zone 1 thickness (MRP, Exhibit 30, page 60). Fejes (1985) compared measured subsidence data from an area above longwall workings in the Wasatch Plateau to theoretical subsidence profiles and states (p. 6) that the "..subsidence profile predicted by the Russian Donets method closely approximates both the magnitude and shape

of the measured profile." The following geologic information about the Donets coal field was provided (telephone conversation, 6/9/87) by Harold Gluskoter, Branch Chief, Coal Division, USGS:

	Coal Field	
	Donets	Wasatch Plateau
Coal Type	High Volatile Bituminous to Anthracite	High Volatile Bituminous B
Age	Carboniferous	Upper Cretaceous
Overburden Lithologies	Marine Limestones and Shales with Lesser Clastic Sandstone	Clastic Sandstones and Lesser Shales
Mining Depth	Greater Than 1,000 Feet	Variable, From Hundreds to Over 1,000 Feet
Tectonic Activity During Deposition	Relatively Stable	Active
Topography	Rolling Hills (similar to Midwest Coal Fields)	Rugged

The comparisons given above identify significant geologic and topographic differences between the Donets and Wasatch Plateau coal fields.

Although the measured and predicted subsidence profiles are in close approximation, the inference that there is "a similarity of strata conditions" between the two coal fields appears to be a tenuous analogy.

Significant differences in topography and attendant overburden thicknesses between the Donets and Wasatch Plateau coal fields suggests dissimilar overburden loading forces and attendant stress fields. The Donets Coal Field is characterized by low relief and hence, the normal stress component due to loading would be relatively uniform above production targets. In the Wasatch Plateau Coal Field where the topography is very rugged and steep canyons

occur immediately adjacent to plateaus, the normal stress component would vary considerably. Variations in the normal stress component are concurrently translated to lateral shear stress. For example, from 200 to 800 feet of overburden have been removed above the segment of NFRF Miller Creek that is projected to be undermined. The minimum normal stress component above the stream segment occurs within 1,500 feet of the maximum normal stress component that occurs along adjacent plateau areas. Consequently, lateral shear stress would be greatest adjacent to the plateau area in close proximity to the unconfined cliffs and decrease rapidly towards the stream channel.

These natural variations in normal and lateral shear stress components promote relatively unstable conditions that enhance rock failure and mass movement processes. Superimposing the proposed sequence of undermining beneath steep slopes suggests shear stresses will readjust in areas that are inherently unstable and consequently, rates of cliff failures and toppling will increase. Moreover, the shape of Zone 1, as shown in the attached figure for confined areas of low relief, may be deformed by variable shear stresses as mining proceeds from plateau areas to beneath steep slopes.

In summary, the implied inference that undermined rocks will fail in a similar manner and Zone 1 will propagate to a height comparable to that measured in the Donets Coal Field is, herein, considered speculative.

Zone 2 - The applicant averages shale occurrences in boreholes (W-1 and F76-10) located adjacent to the New Lands property to derive a minimum thickness (40 feet) for Zone 2. The report by Engineers International (1979) states (p.113) that "...shales adsorb sufficient strain energy before fracturing particularly when they are ductile, but to a lesser extent, as compared to clay beds or mudstones. Thus, somewhat greater thicknesses of aquiclude zone containing fairly high percentages of shale beds will be needed to afford adequate safety for working below the water bodies." Moreover, the report suggests that Zone 2 should be generally free from open cracks and fissures, and its thickness should accommodate small faults, slips and fissures.

An examination of the lithologic data presented in Table 1, Exhibit 30, indicates shale beds constitute approximately 23 and 21 percent of the stratigraphic sections penetrated by boreholes W-1 and F76-10, respectively. Engineers International (1979) calculated a Zone 2 thickness of 90 feet for shaley and silty sandstones (Table 16).

Site-specific lithologic data combined with recommendations by Engineers International (1979) suggests the applicant has underestimated the Zone 2 thickness.

Zone 3 - The applicant assigns a thickness of 45 feet to Zone 1. Engineers International recommends a thickness of 45 to 50 feet. Dunrud (1976, p.9) reported fracture development at the surface about 900 feet above a mine in the Book Cliffs Coal Field. Larger fractures emitted air from the mine workings indicating continuity with the workings.

Forty-one mining-induced fractures at the surface have been identified above previous workings (MRP, Map 62B). All identified surface cracks occur within the Blackhawk Formation. Approximately 83 percent of the cracks trend northerly, the remaining 17 percent trend westerly. Seven surface cracks have been found above single-seam Wattis development and three cracks have formed above Third seam workings. Two surface cracks are present above areas where Wattis and Third seam development have occurred. The remaining 29 surface cracks occur where the Hiawatha seam has been developed alone, or in conjunction with overlying coal seams. Relationships between overburden thickness and the occurrence of surface cracks above Wattis and Third seam workings are tabulated below:

Previous Mine Development

Overburden Thickness	Wattis Seam	Third Seam	Wattis & Third Seam
0-100 ft.	2*		1
100-200 ft.	1		
200-300 ft.	4	1	
300-400 ft.		2	
400-500	-	-	-
500-600			1

* Number of Surface Cracks

Nearly all surface cracks occur above areas that were second mined.

Surface tension cracks and failure have been identified above other mines within the Wasatch Plateau Coal Field. Mining-induced subsidence impacts are briefly summarized below.

Mine(s)	Mining Target(s)	Subsidence Impact	Overburden Thickness	Mining Method
SUFCO	Upper Hiawatha	Cracks Cliff Failure	1,000 ft. 400-600 ft.	Room & pillar
UP&L Complex	Hiawatha, Blind Canyon	Cracks Cliff Failure	600-1000 ft. 600-1000 ft.	Single-and Multiple-Seam Room & Pillar & Longwall
Belina No. 1	Upper O'Conner	Cracks Ground Failure	200-400 ft. 200-400 ft.	Room & Pillar

Utah Power and Light Company concludes in their 1984 Annual Subsidence Report that most fractures occur in steep cliff areas where burned coal is present and the Castlegate Sandstone (or similar lithologic unit) outcrops or is near the surface.

Compliance Assessment

The applicant has derived a methodology for predicting rock failure and thereby, delimits overburden thicknesses to prevent impacts to surface lands. Technical review revealed that certain premises used to predict rock failure may not be directly applicable to the Wasatch Plateau Coal Field. Consequently, derived overburden thicknesses may not be adequate to prevent mining-induced subsidence that causes material damage to the surface.

The Division has, during previous permitting actions, determined mining-induced surface cracks and catastrophic failure to constitute material damage to the surface. Because the occurrence of mining-induced material damage to the surface is, at present, poorly understood, the Division has taken a conservative approach when assessing subsidence-related performance standards. Previous permit approvals (Cottonwood, J. B. King, Gordon Creek #3 and #6, Trail Mountain, Sunnyside, Bear Canyon and Star Point - 5 year renewal) have required plans for mitigating material damage to the surface, even in areas of relatively low relief (plateaus) and thick overburden (greater than 1000 feet) where the potential for mining-induced impacts has presumably been low.

Proposed development within the New Lands property will require Division review of compliance with performance standards under UMC 817.41, 817.57, 817.97 and 817.121-.126. With the exception of UMC 817.126, the above-identified regulations indicate that the nonrenewable resource (coal) shall be developed in a manner to minimize adverse impacts to renewable resources (wildlife, vegetation, hydrologic). The assessments of compliance with the standards of UMC 817.126 is somewhat different in that mining shall not be permitted beneath a perennial stream "unless the Division ... determines that subsidence will not cause material damage which could result in environmental degradation or safety hazards to streams..."

The remainder of this document will assess potential mining-induced impacts to surface lands and whether these impacts will result in minimal adverse impacts to renewable resources or cause material damage that could result in environmental degradation.

Subsidence Assessment

Alternative 1

Allow applicant to longwall mine both the Third and Wattis seams as proposed in the New Lands application.

Minimum Overburden	Potential Surface Impact(s)	Risk
Wattis (400 ft.) and Third (480 ft.)	Tension Cracking	High
	Cliff Failure	High
	Ground Failure	Moderate

Alternative 2 (see attached figure)

Restrict applicant to longwall mining in panel three of the Wattis seam only where overburden exceeds 500 feet. Allow room and pillar mining with pillar retention in panel three of the Wattis seam where overburden thickness is between 400 and 500 feet. Exclude Third seam mining from permit approval until impacts from Wattis seam mining can be assessed.

Minimum Overburden	Potential Surface Impact(s)	Risk
Wattis: Longwall (500 ft.) Room and Pillar (400-500 ft.)	Tension Cracking	Moderately High
	Cliff Failure	Moderately High
	Ground Failure	Low

Alternative 3 (see attached figure)

Restrict applicant to Wattis seam mining with retention of subsidence barriers (1) sized according to the 22.5 degree angle-of-draw, beneath NFRF Miller Creek and (2) past outcropping Castlegate Sandstone. Exclude Third seam mining from permit approval until impacts from Wattis seam mining can be assessed.

Minimum Overburden	Potential Surface Impact(s)	Risk
Wattis: Longwall beneath plateau areas; room and pillar - beneath NFRF Miller Creek and past outcropping Castlegate sandstone	Tension Cracks	Low
	Cliff Failure	Low
	Ground Failure	Low

Adverse Impacts and Environmental Degradation Assessment

The following risk assessments are abstracted from the attached Coal File memoranda by Kathryn M. Mutz (dated 6/23/87) and Tom Munson (dated 6/18/87).

Environmental Assessment

Potential Environmental Affect	Risk		
	Alternative 1	2	3
Loss of Streamflow	High	Mod High	Low
Spring Disruption	Mod High	Mod High	Mod
Decreased Surface Water Quality	Mod High	Mod High	Low
Loss of Raptor Nests	High	Mod High	Mod
Loss of Wildlife Habitat	High	Mod High	Low

Recommendation

It is herein recommended that the potential risk for adversely impacting or degrading environmental resources within the New Lands property be reduced from high to moderate or low by restricting the applicant's mining plan. Accordingly, either Alternative 2 or 3 should be substituted for the proposed mining plan to allow Division technical staff the opportunity to derive findings of compliance with UMC 817.41, 817.57, 817.97 and 817.121-.126.

JJW/pb
cc: J. Whitehead
L. Braxton
K. May
9206R

Based on discussions both internal and with Plateau, I recommend that the alternative listed as "Alternative 2", be followed for the sake of making compliance findings. This course of action is not designed to preclude the applicant from proposing mining in the Third seam, but before such mining can proceed, the ramifications of Wattis seam removal should be reviewed by DOGM. This review should be concluded 1 year prior to proposed 3rd seam mining. L. C. Braxton 7-16-87

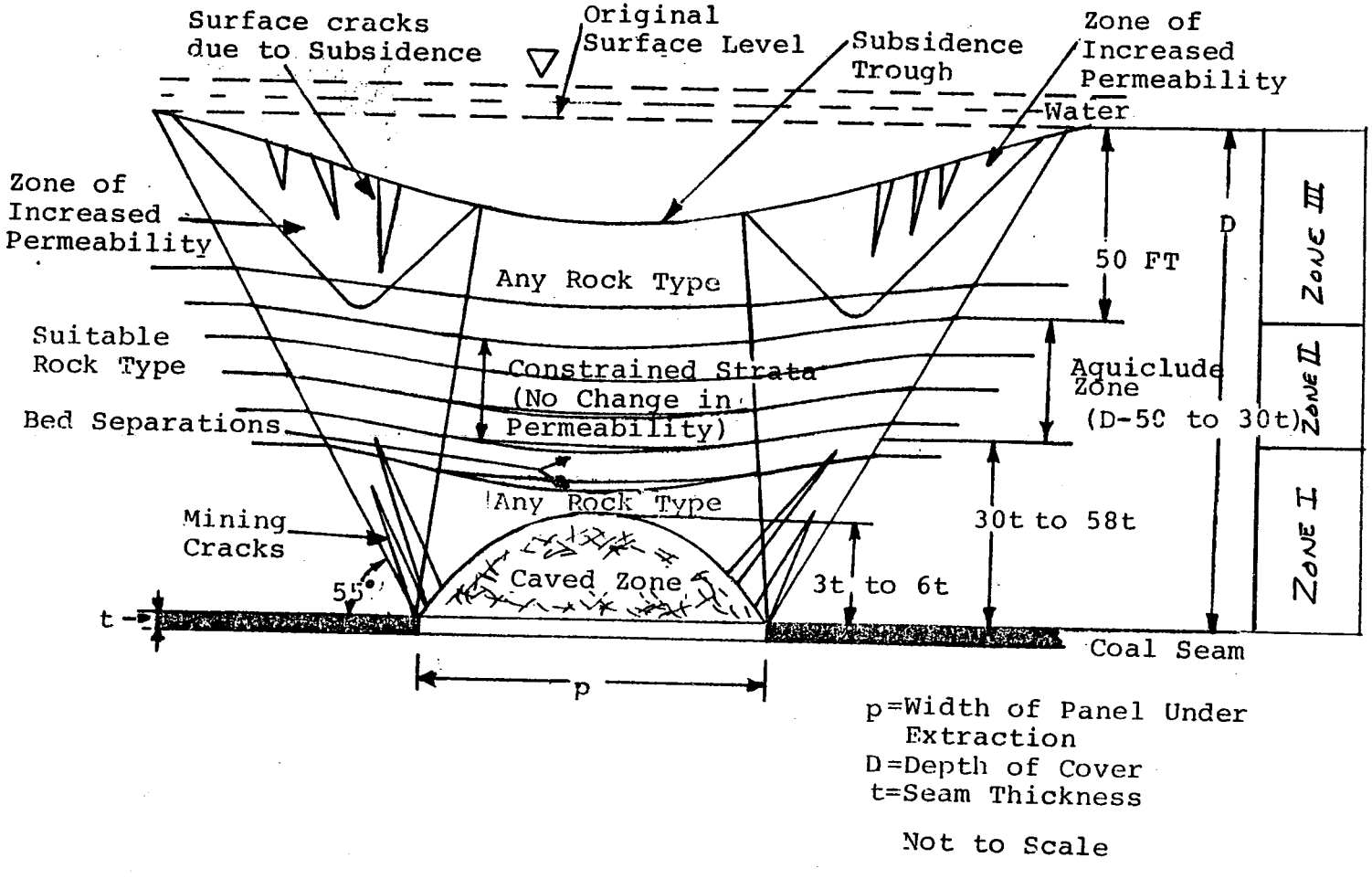
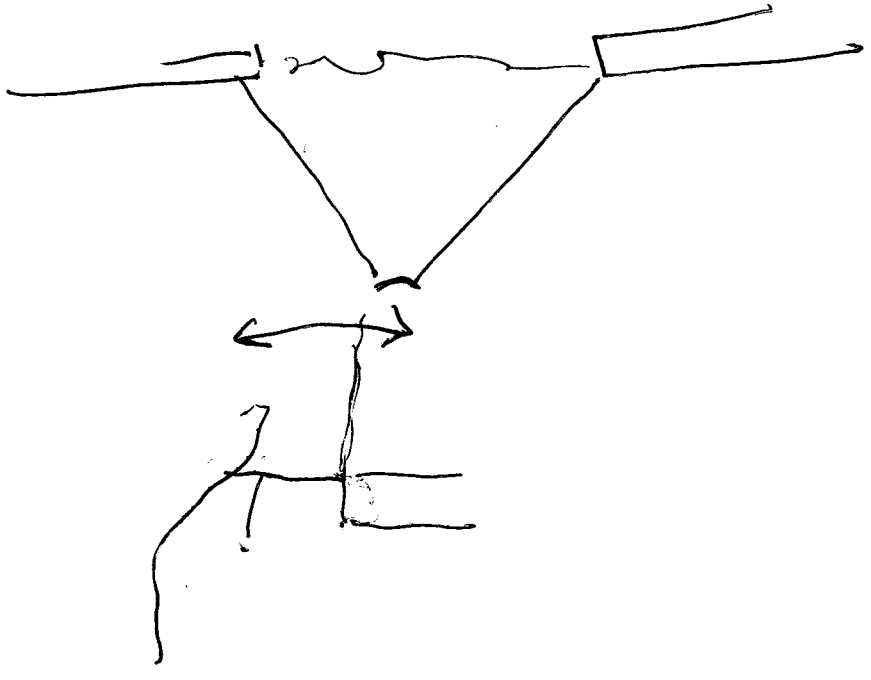


Figure 30 - Generalized Strata Behavior Above a Panel Under Total Extraction



June 18, 1987

TO: Coal File

FROM: Tom Munson, Reclamation Hydrologist TM

RE: Environment Assessment of the Existing Hydrologic Data Relating to the North Fork of the Right Fork (NFRF) of Miller Creek, New Lands Property, Plateau Mining Company, ACT/007/006, Folder #3, Carbon County, Utah

Two sources of data exist to describe the hydrologic characteristics of surface waters found in the North Fork of the Right Fork (NFRF) of Miller Creek. The major source of data is found in Plateau's Annual Water Quality Data Listings through 1986 for station ST-1. This station is located approximately 3.5 miles downstream from the headwaters of the NFRF of Miller Creek.

Six years of record have been recorded at this site. The average flow for this site over the period of record is .56 cfs or 251.3 gpm, with a high flow recorded on 6/13/85 of 2.0 cfs or 897.6 gpm, and a low flow recorded on 2/18/81 of .05 cfs or 22.4 gpm. At this same site the average electrical conductivity was 1334.7 umhos/cm with a high value recorded on 9/17/80 of 1900 umhos/cm, and a low value recorded on 6/22/82 of 370 umhos/cm. Fourteen discharge values were used to complete the average and seventeen conductivity values were used to complete the average.

The second source of data for the NFRF of Miller Creek is a stream survey completed on the upper reaches of the creek in section 18 and 17, T.15S, R8E. The purpose of this survey was to identify the gaining and losing reaches of the creek in these two sections. Flow measurements and conductivity readings were taken approximately every 1,000 feet. All inflows were identified and measured. If mining were to occur as identified in the New Lands Permit application, stations M-1 through M-8 would be the closest to the potentially subsided area. An average of the electrical conductivity readings in this reach of the creek was 391.3 umhos/cm for stations M-4, 6 and 8. The total flow at station M-4 was 21 gpm, station M-6 was 40 gpm, and station M-8 was 62 gpm. The data from each station in this portion of the creek identified each reach in this stretch of creek as a gaining reach. From station M-6 to M-8 was identified as gaining the most flow of +15 gpm.

Conclusions

It is my opinion that the data collected at the downstream station ST-1 does not adequately represent or define what is occurring in the upper reaches of Miller Creek. The variance in electrical conductivity, the abundance of springs, and the physical distance of 3.3 miles between the two sites does not reflect any similarities in data, or provide an avenue for assessment between the two stations.

Recommendations

Both water quality and quantity of flow in the upper reaches of Miller Creek has not been well defined. I feel that a continuous monitoring station at M-8 on Map 29 must be installed, and that data must be collected on a continuous basis for at least two years to define the baseline hydrologic resources of this reach of Miller Creek. Additional stream surveys in July and September to define gaining or losing reaches would be appropriate to define baseflow recharge conditions in this reach. One year of baseline water quality parameters and baseline flow data from a continuous monitoring station at M-8 must be established for this reach of Miller Creek prior to any mining. The accompanying table identifies risk associated with various mining alternatives and potential impacts to the hydrologic resources from subsidence. The lack of baseline data to determine if changes to the hydrologic balance would occur from mining or during mining and any period thereafter makes it essential that this data is collected.

The following regulations apply as general requirements regarding the collection of baseline water quality and quantity to define hydrologic resources and any potential impacts to hydrologic resources from proposed mining.

UMC 817.41(a)
UMC 817.50(d)
UMC 817.50(b)(1)(i)
UMC 817.52(b)(1)(i)
UMC 817.55(c) and (e)
UMC 817.57(2)
UMC 817.26(a)

djh
cc: J. Whitehead
R. Smith
Attachment
9486R/29-30

TABLE 1
RISK ASSESSMENT

North Fork of Right Fork of Miller Creek

	Tension Cracks	Cliff Failure	Ground Movement
Alternative I *			
Stream Flow Loss	High	Moderate	Moderate
Spring Disruption	Moderately High	Moderate	Moderate
Water Quality Degradation	If intercepted by the mine-High) If not-Moderate)	Moderate	Low
Alternative II *			
Stream Flow Loss	Moderately High	Moderate	Low
Spring Disruption	Moderately High	Moderate	Low
Water Quality Degradation	Moderately High	Moderate	Low
Alternative III *			
Stream Flow Loss	Low	Low	Low
Spring Disruption	Moderate	Low	Low
Water Quality Degradation	Low	Low	Low

* Alternatives are spelled out in the Division's Memorandum titled "Review of Proposed Mine Development and Potential Subsidence Impacts", for Plateau Mining's New Lands property.

TM/djh
9486R/31

June 23, 1987

TO: Coal File

FROM: Kathryn M. Mutz, Reclamation Biologist

RE: Impacts of Mining on Biological Resources, New Lands Property, Plateau Mining Company, Folder #3, ACT/007/006, Carbon County.

UNDERMINING THE NORTH FORK OF THE RIGHT FORK OF MILLER CREEK

The following assumptions are made in this discussion:

1. The stream will be undermined as proposed in the New Lands MRP (Alternative 1 of the R. Smith, et al. Mine Development Analysis memo to coal file, 6/15/87);

2. Mining will cause a total or substantial loss of flow from both springs and groundwater recharge to the undermined reach;

3. The stream reach below the undermined section will have reduced flows. The loss of water due to mining should be partially masked by inflow from springs unaffected by mining and from tributaries joining the main channel. Snow accumulation and slope runoff should also continue to provide some flow through this reach.

4. Lost flows will not be replaced by repairing the creek bed with bentonite or grout, as proposed by PMC, until the majority of subsidence movement ceases (e.g. +or- 5 years.)

Undermined Area

The riparian area along the North Fork of the Right Fork of Miller Creek is limited. Much of the zone is constrained by a narrow V-shaped canyon. The riparian zone of the undermined stream reach averages about 24 inches, excluding the width of the stream itself. Riparian vegetation varies along the length of this segment, but generally consists of patches of grasses, willows and other deciduous shrubs, and of conifer species which occupy the adjacent slopes (personal communications L. Dalton). The difference between riparian area and upland vegetation may be more of a difference in vegetation density and vigor than in species composition.

Since the stream has cut to bedrock, the vegetation is supported on a thin mantle of soil which clings to the bedrock. Many of the shrubs of the riparian zone are rooted several inches to a few feet above the canyon bottom. These plants may be deeply rooted in shallow cracks in their rocky substrate and benefit from the water flowing in NFRF Miller Creek. Initial establishment may, however, have required supplemental water (e.g. additional water from above average snowmelt, springs, etc.) or vegetative reproduction from a parent plant in a more mesic (lower) position on the bank.

The stream is considered 'biologically active' according to UMC

817.57 since it is inhabited by at least three species of arthropod (personal communications, L. Dalton). The Utah Division of Wildlife Resources does not, however, consider this reach to have fishery potential.

Downstream of Mining

Portions of the stream about 0.25 mile below the undermined section (0.5 miles below the longwalled area) support a wider (i.e., 20 - 30 feet), more diverse riparian zone. The stream, which is still cut to bedrock, meanders through these small, flat sections. Riparian vegetation on these valley bottoms probably depends on several sources of water including snow accumulation, collection and longer retention of slope runoff (compared to steeper gradient reaches), springs and lateral subsurface flow outward from the stream. This portion of the NFRF Miller Creek is both biologically active and a potential fishery (personal communications, L. Dalton).

Impacts on the Undermined Section

Existing riparian vegetation of the area is limited and may survive (although probably not reproduce) if flow is lost from the stream for a few years until subsidence cracks in the creek can be stabilized. The principal impact of mining would be the loss of water from both the stream (1500-2000 linear feet) and springs. Both deer and elk are significant users of these water sources from the time of fawning and calving, which starts in mid-May, until migration to winter range in late November.

While site specific data are not available, it is likely that small mammals and birds are currently more abundant near the stream than on the forested slopes, particularly in the wider riparian areas. Small herbivores should not be significantly impacted if the vegetation survives but insectivores and other animals more dependent on open water may be adversely affected.

Downstream Impacts

Downstream of the mining (described in assumption #3 above) reduction of water volume may reduce the vigor of vegetation or the size of the riparian zone but should not eliminate it entirely. Terrestrial wildlife use should not be significantly impaired in the reduced flow reach since some water will still be available. The fishery potential may, however, be eliminated in this section, particularly in dry years.

Mitigation

Impacts on large terrestrial wildlife can be mitigated through use of guzzlers at affected springs and along the dewatered stream reach. Along the stream 1000 gallon guzzlers should be installed

approximately every 800 feet (personal communications, L. Dalton). Reduction in stream flow may also be mitigated, as proposed by PMC, by discharging mine water into the stream. Whether or not this is an option will depend on the quality of the water that would be discharged. Mitigation of water quantity loss may not be worth the reduction in water quality that might result.

UNDERMINING CLIFFS:

The Castlegate cliff zone is primarily a fractured rock outcrop with limited grass and forb cover and an occasional tree. The cliff is bordered by Douglas Fir and Aspen vegetation types. The principal wildlife value of the cliff zone is for raptor habitat. Two Golden eagle nests are located on the cliff above longwall panel number 1. Beneath the cliff zone the steep slope vegetation is primarily Douglas Fir with a narrow riparian zone in the canyon bottom.

Impacts of subsidence on biological resources can be categorized as:

1. death of vegetation and/or wildlife by earth movement, the most severe being rock spalling from the cliffs; and
2. loss of wildlife habitat, primarily through the destruction of vegetation or other critical habitat features, e.g. nesting substrates.

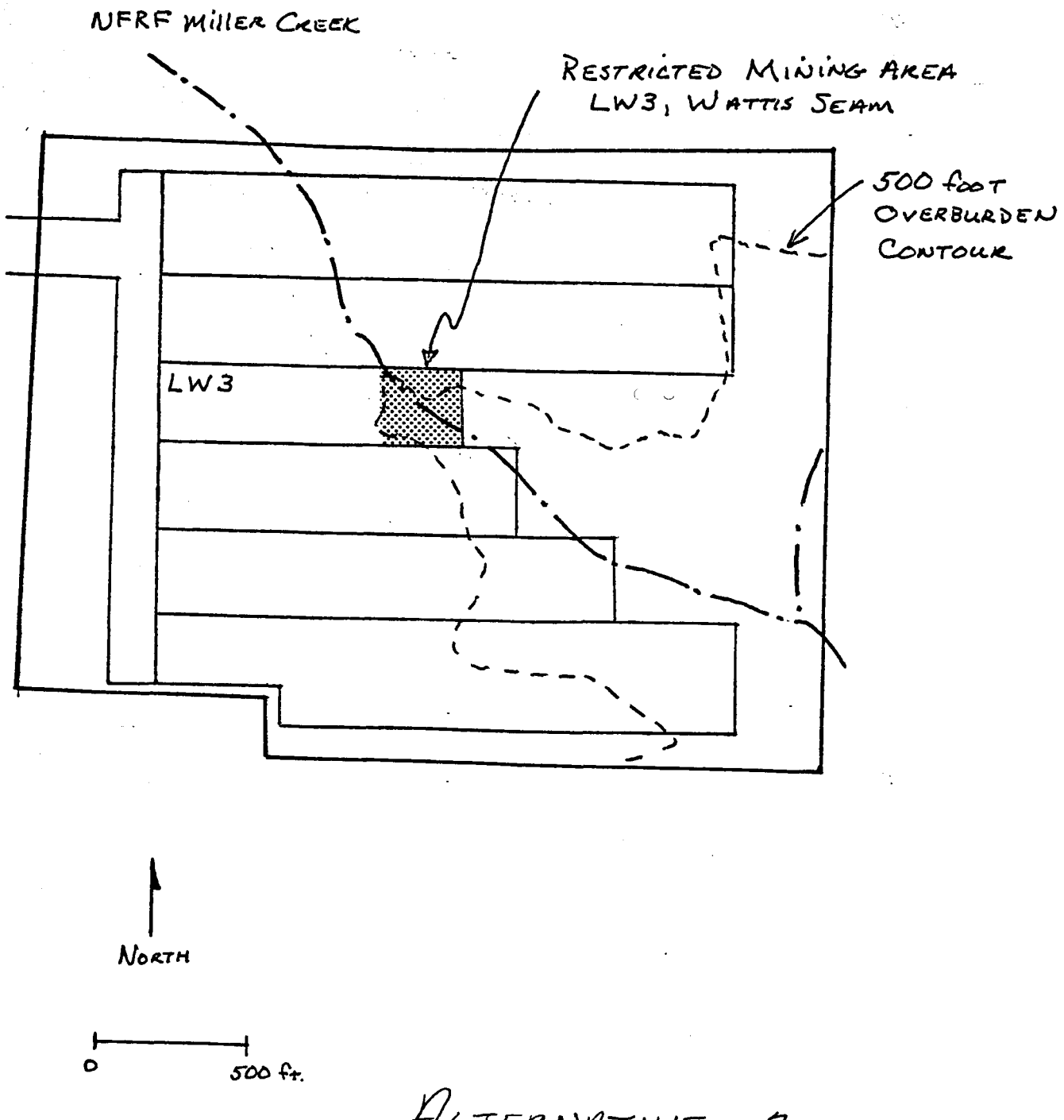
For cliff spalling, the degree of impact will depend on the manner in which the cliff fails. Abrupt failure of a massive cliff is likely to cause significant loss of vegetation beneath the cliff. Dense tree cover beneath the cliff may ameliorate the impact of small rock falls. Any cliff spalling will, of course, destroy vegetation and wildlife currently occupying the portion of cliff that spalls.

Minimizing Impacts

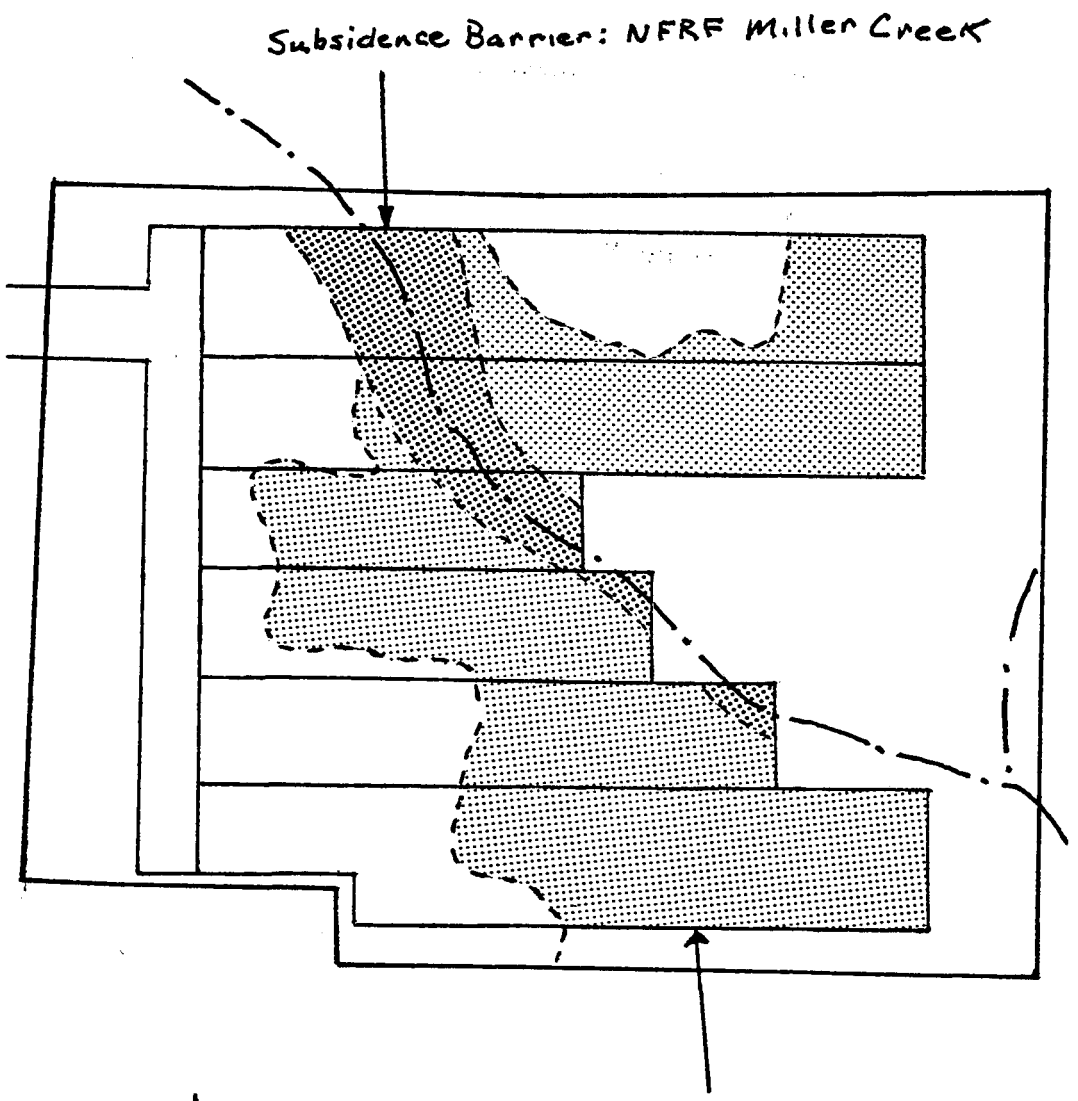
If the cliffs are undermined, as proposed in Alternative 1, there is no practical way to minimize impacts on the vegetation resource of the cliffs or canyon slopes or on the general wildlife population of the area (e.g. primarily small mammals and birds). Impacts on the Golden eagles could be altered by preventing use of the existing nests in the subsidence zone. An alternate nest, outside the impact zone, might be used until the danger of cliff failure is over. The pros and cons of this approach are currently under consideration by USFWS and UDWR.

Mitigation

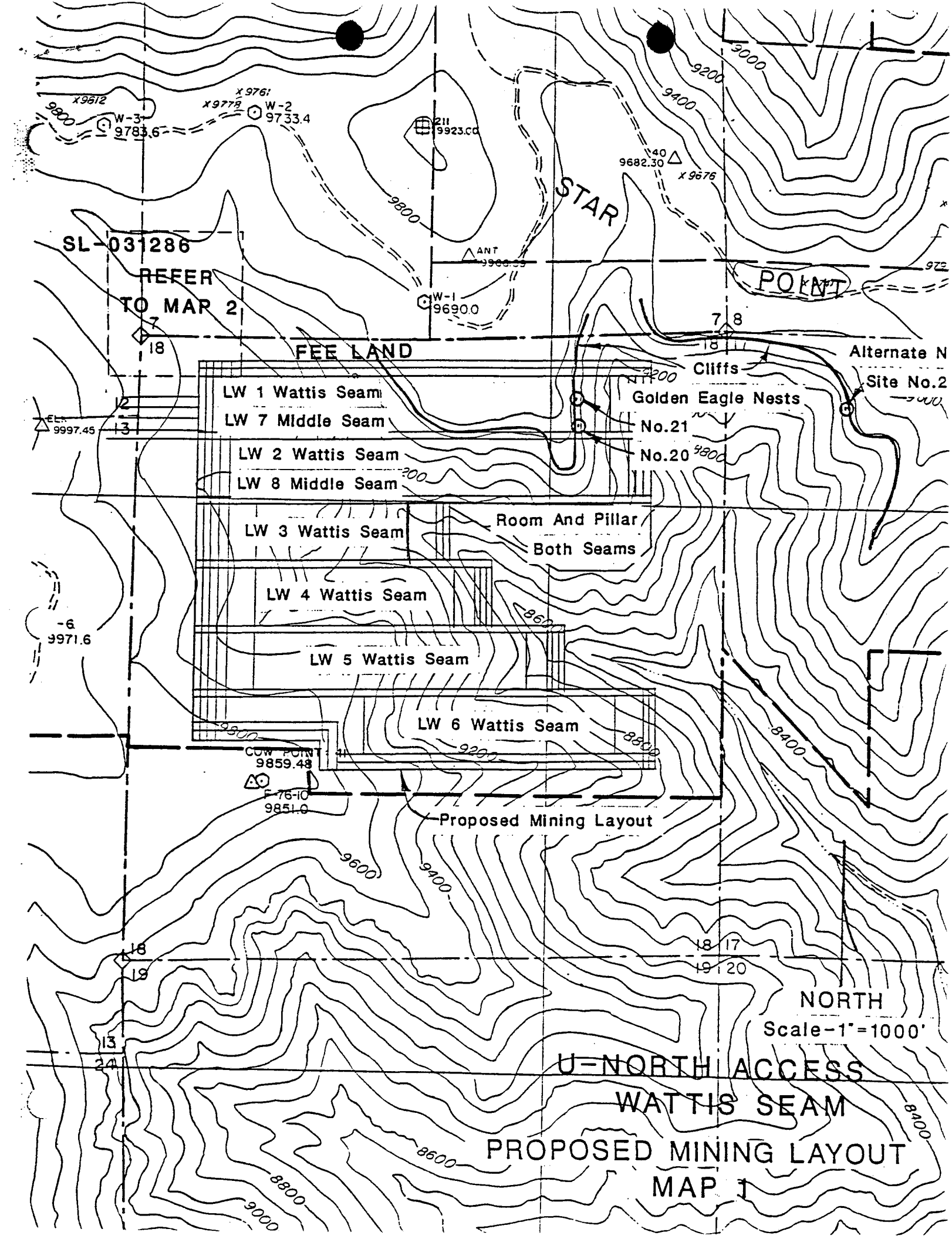
Mitigation for loss of vegetation resources could include revegetation, particularly tree planting. Mitigation for loss of raptor nests and nesting habitat might include artificial nests or modification of the cliff substrate.



Alternative 2.



ALTERNATIVE 3.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Room And Pillar
Both Seams
Cliffs
Golden Eagle Nests
No.21
No.20
Alternate N
Site No.2
Proposed Mining Layout
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U-NORTH ACCESS
WATTIS SEAM
PROPOSED MINING LAYOUT
MAP 1