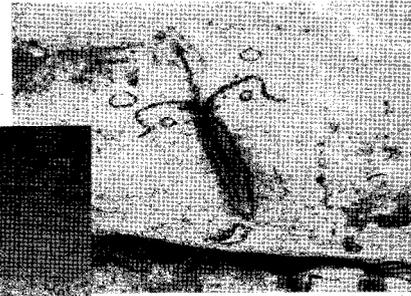


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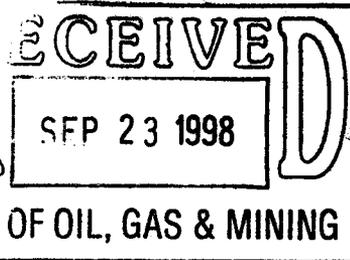
PINES TRACT PROJECT

Draft Environmental Impact Statement



This is a DEIS conducted through the NEPA process on the Manti-La Sal National Forest by JBR Environmental Consultants, Inc.





PINES TRACT PROJECT

**PINES FEDERAL COAL LEASE TRACT UTU-76195
MODIFICATION TO FEDERAL COAL LEASE U-63214
PERMIT AMENDMENT APPLICATION TO SUBSIDE BOX CANYON
EMERY AND SEVIER COUNTIES, UTAH**

DRAFT ENVIRONMENTAL IMPACT STATEMENT

Responsible Agencies:

U.S.D.A. FOREST SERVICE (Lead Agency)
Manti-La Sal National Forest

U.S.D.I. BUREAU OF LAND MANAGEMENT
Utah State Office

Responsible Officials:

Janette S. Kaiser - Forest Supervisor
Manti-La Sal National Forest
599 W. Price River Drive
Price, Utah 84501

G. William Lamb, Director
Bureau of Land Management
Utah State Office
324 South State Street, Suite 301
Salt Lake City, Utah 84145

Cooperating Agency:

U.S.D.I. Office of Surface Mining, Reclamation and Enforcement
Western Regional Coordinating Center
1999 Broadway, Suite 3320
Denver, Colorado 80202-5733

**For Further Information
Contact:**

Liane Mattson or Carter Reed
Manti-La Sal National Forest
599 W. Price River Drive
Price, Utah 84501
(435) 637-2817

ABSTRACT:

This Draft Environmental Impact Statement (DEIS) is written in response to applications submitted by Canyon Fuel Company, LLC to access federal coal reserves on the Manti-La Sal National Forest. The Pines Tract Project DEIS analyzes three Federal actions or components that require decisions by the responsible officials of the USDA-FS and USDI-BLM. The three project components are: 1) Offer the Pines Coal Lease Tract (UTU-76195) for competitive leasing as delineated by the Interagency Tract Delineation Team; 2) Modify the Quitcupah Lease (Federal Coal Lease U-64213) by adding 150 acres of Federal coal lands to provide maximum recovery of the coal reserves in the area; and 3) Amend the Permit Application Package for the SUFCO Mine to allow longwall full-extraction mining and subsidence of Box Canyon and the associated perennial drainage. Four alternatives were considered for analysis: A) No Action Alternative/No Lease Alternative/No Subsidence of Box Canyon, B) Lease the proposed areas with Standard BLM Lease Terms and Conditions, C) Lease the proposed areas with Standard BLM Lease Terms and Conditions, and Special Coal Lease Stipulations for Protection of Non-Coal Resources, and D) Lease the proposed areas with Standard BLM Lease Terms and Conditions, and Special Coal Lease Stipulations for Protection of Non-Coal Resources, allowing subsidence of perennial drainages and escarpments in the analysis area. The responsible officials of the BLM and FS have identified Alternative C, with modifications, as the preferred alternative.

The DEIS for this project was released for a 45-day public review and comment on September 25, 1998. Comments on this DEIS must be submitted to the Forest Supervisor of the Manti-La Sal National Forest no later than November 9, 1998.

Reviewers should provide the Forest Service with their comments during the review period of the DEIS. This will enable the Forest Service to analyze and respond to the comments at one time and to use information acquired in the preparation of the FEIS, thus avoiding undue delay in the decision making process. Reviewers have an obligation to structure their participation in the National Environmental Policy Act process so that it is meaningful and alerts the agency to the reviewers' position and contentions. *Vermont Yankee Nuclear Power Corp. v. NRDC*, 435 U.S. 519, 553 (1978). Environmental objections that could have been raised at the draft stage may be waived if not raised until after completion of the FEIS. *City of Angoon v. Hodel* (9th Circuit, 1966) and *Wisconsin Heritages, Inc. v. Harris*, 490 F. Supp. 1334, 1338 (E.D. Wis. 1980). Comments on the DEIS should be specific and should address the adequacy of the statement and the merits of the alternatives discussed (40 CFR 1503.3).

TABLE OF CONTENTS

TABLE OF CONTENTS	i
LIST OF FIGURES	vii
LIST OF TABLES	viii
LIST OF ACRONYMS & ABBREVIATIONS	ix
LIST OF APPENDICES	xi
EXECUTIVE SUMMARY	xiii
1.0 INTRODUCTION	1-1
1.1 PURPOSE AND NEED	1-2
1.2 GENERAL LOCATION	1-3
1.3 LEASING PROCESS/AUTHORIZING ACTIONS	1-3
1.3.1 Lease Pines Coal Lease Tract (UTU-76195)	1-8
1.3.2. Modify Federal Coal Lease U-63214 (Quitcupah Lease)	1-9
1.3.3 PAP Amendment to Subside Box Canyon	1-9
1.4 DECISIONS TO BE MADE BY RESPONSIBLE OFFICIALS	1-10
1.5 HISTORICAL MINING AND REASONABLY FORESEEABLE DEVELOPMENT	1-11
2.0 ISSUES AND ALTERNATIVES INCLUDING THE PROPOSED ACTION	2-1
2.1 PUBLIC INVOLVEMENT PROCESS	2-1
2.2 ISSUES CARRIED FORWARD IN ANALYSIS	2-2
2.3 ISSUES NOT ANALYZED IN DETAIL	2-8
2.4 PROJECT ALTERNATIVES	2-12
2.4.1 No Action Alternative	2-14
2.4.2 Alternative B	2-14
2.4.3 Alternative C	2-16
2.4.4 Alternative D	2-16
2.5 OTHER SCENARIOS CONSIDERED BUT ELIMINATED FROM DETAILED STUDY	2-18
2.6 SUMMARY COMPARISON OF ALTERNATIVES RELATIVE TO ISSUES	2-18
2.7 PAST, PRESENT, REASONABLY FORESEEABLE FUTURE ACTIONS	2-18
3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES	3-1
3.1 TOPOGRAPHY, GEOLOGY, AND SUBSIDENCE	3-3
3.1.1 Affected Environment	3-3
3.1.2 Environmental Consequences	3-19
3.1.2.1 No Action Alternative	3-20
3.1.2.2 Alternative B	3-20
3.1.2.3 Alternative C	3-23
3.1.2.4 Alternative D	3-24
3.1.3 Mitigation and Monitoring	3-25

TABLE OF CONTENTS (cont.)

	3.1.4	Cumulative Effects	3-26
	3.1.5	Residual Adverse Impacts	3-26
	3.1.6	Irreversible/Irretrievable Commitment of Resources	3-26
	3.1.7	Short Term Uses vs. Long Term Productivity	3-26
3.2		GROUNDWATER	3-27
	3.2.1	Affected Environment	3-27
	3.2.2	Environmental Consequences	3-42
		3.2.2.1 No Action Alternative	3-42
		3.2.2.2 Alternative B	3-42
		3.2.2.3 Alternative C	3-54
		3.2.2.4 Alternative D	3-55
	3.2.3	Mitigation and Monitoring	3-55
	3.2.4	Cumulative Effects	3-56
	3.2.5	Residual Adverse Impacts	3-56
	3.2.6	Irreversible/Irretrievable Commitment of Resources	3-56
	3.2.7	Short Term Uses vs. Long Term Productivity	3-57
3.3		SURFACE WATER	3-58
	3.3.1	Affected Environment	3-58
	3.3.2	Environmental Consequences	3-69
		3.3.2.1 No Action Alternative	3-69
		3.3.2.2 Alternative B	3-70
		3.3.2.3 Alternative C	3-77
		3.3.2.4 Alternative D	3-78
	3.3.3	Mitigation and Monitoring	3-79
	3.3.4	Cumulative Effects	3-80
	3.3.5	Residual Adverse Impacts	3-81
	3.3.6	Irreversible/Irretrievable Commitment of Resources	3-81
	3.3.7	Short Term Uses vs. Long Term Productivity	3-81
3.4		SOILS	3-82
	3.4.1	Affected Environment	3-82
	3.4.2	Environmental Consequences	3-88
		3.4.2.1 No Action Alternative	3-88
		3.4.2.2 Alternative B	3-88
		3.4.2.3 Alternative C	3-90
		3.4.2.4 Alternative D	3-90
	3.4.3	Mitigation and Monitoring	3-90
	3.4.4	Cumulative Effects	3-90
	3.4.5	Residual Adverse Impacts	3-91
	3.4.6	Irreversible/Irretrievable Commitment of Resources	3-91
	3.4.7	Short Term Uses vs. Long Term Productivity	3-91
3.5		VEGETATION	3-92
	3.5.1	Affected Environment	3-92
	3.5.2	Environmental Consequences	3-99
		3.5.2.1 No Action Alternative	3-99

TABLE OF CONTENTS (cont.)

	3.5.2.2	Alternative B	3-100
	3.5.2.3	Alternative C	3-102
	3.5.2.4	Alternative D	3-103
	3.5.3	Mitigation and Monitoring	3-104
	3.5.4	Cumulative Effects	3-105
	3.5.5	Residual Adverse Impacts	3-106
	3.5.6	Irreversible/Irretrievable Commitment of Resources	3-106
	3.5.7	Short Term Uses vs. Long Term Productivity	3-107
3.6		WILDLIFE	3-108
	3.6.1	Affected Environment	3-108
	3.6.2	Environmental Consequences	3-113
	3.6.2.1	No Action Alternative	3-113
	3.6.2.2	Alternative B	3-113
	3.6.2.3	Alternative C	3-118
	3.6.2.4	Alternative D	3-119
	3.6.3	Mitigation and Monitoring	3-121
	3.6.4	Cumulative Effects	3-122
	3.6.5	Residual Adverse Impacts	3-122
	3.6.6	Irreversible/Irretrievable Commitment of Resources	3-123
	3.6.7	Short Term Uses vs. Long Term Productivity	3-123
3.7		SPECIAL STATUS SPECIES	3-124
	3.7.1	Affected Environment	3-124
	3.7.2	Environmental Consequences	3-140
	3.7.2.1	No Action Alternative	3-145
	3.7.2.2	Alternative B	3-145
	3.7.2.3	Alternative C	3-148
	3.7.2.4	Alternative D	3-149
	3.7.3	Mitigation and Monitoring	3-150
	3.7.4	Cumulative Effects	3-151
	3.7.5	Residual Adverse Impacts	3-152
	3.7.6	Irreversible/Irretrievable Commitment of Resources	3-152
	3.7.7	Short Term Uses vs. Long Term Productivity	3-152
3.8		CULTURAL RESOURCES AND PALEONTOLOGY	3-153
	3.8.1	Cultural Resources	3-153
	3.8.1.1	Affected Environment	3-153
	3.8.1.2	Environmental Consequences	3-160
	3.8.1.2.1	No Action Alternative	3-160
	3.8.1.2.2	Alternative B	3-161
	3.8.1.2.3	Alternative C	3-165
	3.8.1.2.4	Alternative D	3-165
	3.8.1.3	Mitigation and Monitoring	3-165
	3.8.1.4	Cumulative Effects	3-168
	3.8.1.5	Residual Adverse Impacts	3-168
	3.8.1.6	Irreversible/Irretrievable Commitment of Resources	3-168

TABLE OF CONTENTS (cont.)

	3.8.1.7 Short Term Uses vs. Long Term Productivity	3-168
3.8.2	Paleontology	3-168
	3.8.2.1 Affected Environment	3-168
	3.8.2.2 Environmental Consequences	3-169
	3.8.2.2.1 No Action Alternative	3-170
	3.8.2.2.2 Alternative B	3-170
	3.8.2.2.3 Alternative C	3-170
	3.8.2.2.4 Alternative D	3-170
	3.8.2.3 Mitigation and Monitoring	3-170
	3.8.2.4 Cumulative Effects	3-171
	3.8.2.5 Residual Adverse Impacts	3-171
	3.8.2.6 Irreversible/Irretrievable Commitment of Resources	3-171
	3.8.2.7 Short Term Uses vs. Long Term Productivity	3-171
3.9	LAND USE AND RECREATION	3-172
	3.9.1 Affected Environment	3-172
	3.9.2 Environmental Consequences	3-178
	3.9.2.1 No Action Alternative	3-178
	3.9.2.2 Alternative B	3-178
	3.9.2.3 Alternative C	3-180
	3.9.2.4 Alternative D	3-181
	3.9.3 Mitigation and Monitoring	3-181
	3.9.4 Cumulative Effects	3-181
	3.9.5 Residual Adverse Impacts	3-182
	3.9.6 Irreversible/Irretrievable Commitment of Resources	3-182
	3.9.7 Short Term Uses vs. Long Term Productivity	3-182
3.10	RANGE RESOURCES	3-183
	3.10.1 Affected Environment	3-183
	3.10.2 Environmental Consequences	3-187
	3.10.2.1 No Action Alternative	3-187
	3.10.2.2 Alternative B	3-187
	3.10.2.3 Alternative C	3-190
	3.10.2.4 Alternative D	3-192
	3.10.3 Mitigation and Monitoring	3-192
	3.10.4 Cumulative Effects	3-193
	3.10.5 Residual Adverse Impacts	3-194
	3.10.6 Irreversible/Irretrievable Commitment of Resources	3-194
	3.10.7 Short Term Uses vs. Long Term Productivity	3-194
3.11	VISUAL RESOURCES AND NOISE	3-195
	3.11.1 Visual Resources	3-195
	3.11.1.1 Affected Environment	3-195
	3.11.1.2 Environmental Consequences	3-197
	3.11.1.2.1 No Action Alternative	3-197
	3.11.1.2.2 Alternative B	3-198
	3.11.1.2.3 Alternative C	3-202

TABLE OF CONTENTS (cont.)

		3.11.1.2.4 Alternative D	3-202
	3.11.1.3	Mitigation and Monitoring	3-203
	3.11.1.4	Cumulative Effects	3-203
	3.11.1.5	Residual Adverse Impacts	3-203
	3.11.1.6	Irreversible/Irretrievable Commitment of Resources	3-204
	3.11.1.7	Short Term Uses vs. Long Term Productivity	3-204
3.11.2	Noise		3-204
	3.11.2.1	Affected Environment	3-204
	3.11.2.2	Environmental Consequences	3-206
	3.11.2.2.1	No Action Alternative	3-206
	3.11.2.2.2	Alternative B	3-206
	3.11.2.2.3	Alternative C	3-207
	3.11.2.2.4	Alternative D	3-208
	3.11.2.3	Mitigation and Monitoring	3-208
	3.11.2.4	Cumulative Effects	3-208
	3.11.2.5	Residual Adverse Impacts	3-208
	3.11.2.6	Irreversible/Irretrievable Commitment of Resources	3-208
	3.11.2.7	Short Term Uses vs. Long Term Productivity	3-208
3.12	AIR QUALITY		3-209
	3.12.1	Affected Environment	3-209
	3.12.2	Environmental Consequences	3-222
	3.12.2.1	No Action Alternative	3-222
	3.12.2.2	Alternative B	3-223
	3.12.2.3	Alternative C	3-225
	3.12.2.4	Alternative D	3-226
	3.12.3	Mitigation and Monitoring	3-226
	3.12.4	Cumulative Effects	3-228
	3.12.5	Residual Adverse Impacts	3-228
	3.12.6	Irreversible/Irretrievable Commitment of Resources	3-228
	3.12.7	Short Term Uses vs. Long Term Productivity	3-228
3.13	TRANSPORTATION		3-229
	3.13.1	Affected Environment	3-229
	3.13.2	Environmental Consequences	3-237
	3.13.2.1	No Action Alternative	3-237
	3.13.2.2	Alternative B	3-237
	3.13.2.3	Alternative C	3-242
	3.13.2.4	Alternative D	3-242
	3.13.3	Mitigation and Monitoring	3-242
	3.13.4	Cumulative Effects	3-243
	3.13.5	Residual Adverse Impacts	3-243
	3.13.6	Irreversible/Irretrievable Commitment of Resources	3-244
	3.13.7	Short Term Uses vs. Long Term Productivity	3-244
3.14	SOCIOECONOMICS AND COAL RECOVERABILITY		3-245
	3.14.1	Affected Environment	3-245

TABLE OF CONTENTS (cont.)

3.14.2	Environmental Consequences	3-247
3.14.2.1	No Action Alternative	3-247
3.14.2.2	Alternative B	3-248
3.14.2.3	Alternative C	3-249
3.14.2.4	Alternative D	3-250
3.14.3	Mitigation and Monitoring	3-250
3.14.4	Cumulative Effects	3-250
3.14.5	Residual Adverse Impacts	3-251
3.14.6	Irreversible/Irretrievable Commitment of Resources	3-251
3.14.7	Short Term Uses vs. Long Term Productivity	3-251
4.0	CONSULTATION AND COORDINATION	4-1
4.1	SUMMARY OF COMMENTS	4-1
4.2	PUBLIC INVOLVEMENT PLAN SUMMARY	4-1
4.3	LIST OF AGENCIES, ORGANIZATION AND PERSONS TO WHOM COPIES OF THE STATEMENT ARE SENT	4-2
5.0	LIST OF PREPARERS AND REVIEWERS	5-1
5.1	LIST OF PREPARERS	5-1
5.2	LIST OF REVIEWERS	5-2
6.0	BIBLIOGRAPHY	6-1
7.0	GLOSSARY	7-1
8.0	INDEX	8-1

LIST OF FIGURES

Figure ES-i	Areas Identified for Protection under Preferred Alternative	xxxvi
Figure 1-1	Regional Location	1-4
Figure 1-2	Project Location	1-5
Figure 1-3	Project Components	1-6
Figure 1-4	Typical Longwall Schematic	1-13
Figure 2-1	Alternative B	2-15
Figure 2-2	Alternatives C and D	2-17
Figure 2-3	Coal Activity in Region, Inclusive of Wasatch Plateau, Bookcliffs, and Emery Coal Fields	2-27
Figure 3-1	Geology Map	3-5
Figure 3-2	Upper Hiawatha Coal Seam Overburden	3-7
Figure 3-3	Generalized Lithologic Column For The Project Area	3-10
Figure 3-4	Locations of Springs, Streams, and Wells in the Project Area	3-28
Figure 3-5	Hydrographs of Springs in the Project Area	3-35
Figure 3-6	Hydrographs of Springs in the Project Area	3-37
Figure 3-7	Plot of Total Spring Discharge Rates in Intervals Above The Mined Coal Seam	3-41
Figure 3-8	Surface Water Resources	3-59
Figure 3-9	Soil Types	3-83
Figure 3-10	Vegetation Types	3-93
Figure 3-11	Springs, Seeps, and Riparian Areas	3-97
Figure 3-12	Forest Management Units	3-109
Figure 3-13	Land Use	3-173
Figure 3-14	Recreation Opportunity Spectrum	3-174
Figure 3-15	Management Area Direction	3-175
Figure 3-16	Rare II Areas	3-177
Figure 3-17	Range Improvements	3-185
Figure 3-18	Visual Quality Objective Map	3-196
Figure 3-19	Areas of Potentially Effected Escarpment	3-199
Figure 3-20	Noise Receptors	3-205
Figure 3-21	Class I Distances	3-211
Figure 3-22	Wind Frequency Distribution	3-213
Figure 3-23	Quarterly Wind Frequency Distribution	3-214
Figure 3-24	Regional PM ₁₀ Impact From Haul Roads	3-227
Figure 3-25	Regional Transportation	3-230
Figure 3-26	General Transportation	3-231
Figure 3-27	Local Transportation	3-232

LIST OF TABLES

Table ES.i	Comparison of Alternatives	xxvii
Table 1.1	Decisions and Authorizations Required for the Proposed Action	1-10
Table 1.2	Decisions and Authorizations for the Proposed Action	1-10
Table 2.1	Comparison of Alternatives	2-19
Table 3.1	Index of Springs and Creeks in the Pines Tract Project Area	3-30
Table 3.2	Federally Listed Threatened, Endangered, Proposed, and Candidate Species Potentially Occurring within the Pines Tract Project Area	3-125
Table 3.3	USDA-FS Sensitive Species Which have the Potential to Occur in the Pines Tract Project Area	3-133
Table 3.4	Potential Occurrence and Effects Analysis of Federally Listed Threatened, Endangered, Potentially Endangered and Candidate Plant and Animal Species in the Pines Tract Project Area	3-141
Table 3.5	Potential Occurrence and Effects Analysis of USDA-FS Sensitive Plant and Animal Species in the Pines Tract Project Area	3-143
Table 3.6	Previous Inventories Conducted Within 1 Mile of the Pines Tract Project Area	3-154
Table 3.7	Cultural Resource Sites within the Pines Tract Project Area	3-156
Table 3.8	Possible Historic Properties Within the Pines Tract Project Area	3-159
Table 3.9	Mining Subsidence Affects Determination on Cultural Resource Sites Within the Pines Tract Project Area	3-162
Table 3.10	Cultural Resource Sites Within the Pines Tract Project Area Potentially Affected by Alternatives	3-164
Table 3.11	Proposed Mitigation for National Register Eligible and Unevaluated Sites Within and adjacent to the Pines Tract Project Area	3-167
Table 3.12	Estimated AUMs associated with water troughs and ponds within the Pines Coal Lease Tract and Lease Modification Area	3-188
Table 3.13	Sound Levels Associated with Ordinary Noise Sources	3-204
Table 3.14	Temperature Statistics for Salina, Utah	3-216
Table 3.15	Major Source and PSD Significant Emissions	3-217
Table 3.16	Air Pollution Sources in Sevier, Sanpete, and Emery County	3-219
Table 3.17	Applicable Ambient Air Concentrations	3-220
Table 3.18	Transportation Routes	3-229
Table 3.19	1996 Highway Traffic Volumes	3-233
Table 3.20	Convulsion Canyon Road Traffic Volumes	3-239
Table 3.21	Design Criteria	3-240
Table 3.22	Link Canyon Road to SR-10 North Traffic Volumes with Another Company	3-241
Table 3.23	Sevier County Economic and Demographic Summary	3-245
Table 3.24	Emery County Economic and Demographic Summary	3-246
Table 3.25	Coal Recovery by Alternative (million tons)	3-249

LIST OF ACRONYMS & ABBREVIATIONS

AERC	Archeological-Environmental Research Corporation
AIRS	Aerometric Information Resource System
AMP	Allotment Management Plan
AO	Approval Order
Army Corps	United States Army Corps of Engineers
AUM	Animal Unit Month
BA	Biological Assessment
BC	before Christ
BE	Biological Evaluation (also Beneficial Effect)
BLM	Bureau of Land Management
Canyon Fuel	Canyon Fuel Company, LLC
cfs	cubic feet per second
CO	carbon monoxide
cy	cubic yards
dB	decibel
dBA	decibel-A weighted
DN	decision notice
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act of 1973, as amended
FONSI	Finding of No Significant Impact
FS	Forest Service
gpm	gallons per minute
HP	horse power
I-70	Interstate Highway 70
IBC	Incidental Boundary Change
kV	kilovolt
MA-LAA	May Affect-Likely to Adversely Affect
MA-NLA	May Affect-Not Likely to Adversely Affect
mbf	million board feet
MER	maximum economic recovery
MIIH	May Impact Individuals or Habitat, But Will Not Likely Contribute to a Trend Towards Federal Listing or Cause a Loss of Viability to the Population or Species
MLS	Manti-La Sal National Forest
mmtpy	million metric tons per year
mph	miles per hour
MRP	Mining and Reclamation Plan
MSL	mean sea level
NAAQS	National Ambient Air Quality Standards
NE	No Effect
NEPA	National Environmental Policy Act
NI	No Impact
NOI	Notice of Intent

LIST OF ACRONYMS & ABBREVIATIONS (cont.)

NO _x	nitrogen oxides
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSR	New Source Review
ORV	off-road vehicle
OSM	Office of Surface Mining, Reclamation and Enforcement
PAP	Permit Application Package
PM	particulate matter
PM ₁₀	particulate matter less than 10 μ m
RARE	Roadless Area Review and Evaluation
RFDS	Reasonably Foreseeable Development Scenarios
RVD	recreation visitor days
SCLS	Special Coal Lease Stipulations
SMCRA	Surface Mining Control and Reclamation Act of 1977
sp.	species (of a specified Genus, with species unidentified)
SR-10	State Route 10
SUFCA	Southern Utah Fuel Company
TDS	Total dissolved solids
tpy	tons per year
UAC	Utah Administrative Code
UDAQ	Utah Division of Air Quality
UDOGM	Utah Division of Oil, Gas, and Mining
UDOT	Utah Department of Transportation
UPDES	Utah Pollution Discharge Elimination System
USDA-FS	United States Department of Agriculture - Forest Service
USDI	United States Department of the Interior
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USHPO	Utah State Historic Preservation Office
VOC	volatile organic compounds
VQO	Visual Quality Objective
VTD	vehicle trips per day
WIFV	Will Impact Individuals or Habitat With a Consequence that the Action Will Contribute to a Trend Towards Federal Listing or Cause a Loss of Viability to the Population or Species

LIST OF APPENDICES

- Appendix A Legal Descriptions of the Pines Tract Project Area
- Appendix B Past, Present, Reasonably Foreseeable Future Actions
- Appendix C BLM Standard Coal Lease Terms and Conditions
- Appendix D Special Coal Lease Stipulations

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EXECUTIVE SUMMARY

I. INTRODUCTION

The Pines Tract Project environmental impact statement (EIS) analyzes three Federal actions or components that require decisions by the responsible officials of the United States Department of Agriculture, Forest Service (USDA-FS) and United States Department of the Interior (USDI), Bureau of Land Management (BLM). All three components involve Federal coal lands within the National Forest System administered by the Manti-La Sal National Forest (MLS), Ferron/Price Ranger District. The three actions are as follows:

1. Offer the Pines Coal Lease Tract (UTU-76195) for competitive leasing as delineated by the Interagency Tract Delineation Team.

The tract being considered in the analysis encompasses approximately 7,311 acres. It is located on the MLS in Sevier and Emery Counties, Utah. (Figures 1-1, 1-2, and 1-3).

2. Modify the Quitchupah Lease (Federal Coal Lease U-64213) by adding 150 acres of Federal coal lands to provide maximum recovery of the coal reserves in the area.

The existing Quitchupah Lease lies within the approved permit area for the SUFCO Mine. The existing lease and proposed lease modification are located on the MLS in Sevier County, Utah (Figures 1-1, 1-2, and 1-3).

3. Amend the Permit Application Package (PAP) for the SUFCO Mine to allow longwall full-extraction mining and subsidence of Box Canyon and the associated perennial drainage (currently not allowed by a lease stipulation and the SUFCO Mine permit).

The proposed PAP amendment area is located on the MLS in Sevier County, Utah (Figures 1-1, 1-2, and 1-3).

II. PURPOSE AND NEED

The following discussions describe the need for the proposed actions and the reasons for the applications that led to the analysis of the proposed actions. Each of the three proposed actions or components are described separately.

Pines Coal Lease Tract

Canyon Fuel Company, LLC (Canyon Fuel) (then Coastal States Energy Company), owner and operator of the SUFCO Mine, submitted a coal lease application for the Pines Coal Lease Tract (UTU-76195) to the BLM on December 16, 1996. The proposed tract encompassed 5,786.90 acres. The Tract was subsequently enlarged by the Tract Delineation Team for leasing consideration in this analysis. It was proposed by Canyon Fuel to increase annual production and the life of the their adjacent SUFCO Mine. The tract lies directly adjacent to the east boundary of the approved permit area.

Even though the lease application was submitted by Canyon Fuel, it would be analyzed under BLM's Lease-on-Application Process (43 CFR 3425) and, if approved for leasing, would be offered by competitive bid.

The EIS considers the effects of Reasonably Foreseeable Development Scenarios that involve underground mining of the coal in the considered lease areas by either Canyon Fuel from the adjacent workings or by another company through new portal facilities in Link Canyon. The EIS also considers other reasonably foreseeable surface developments such as ventilation breakouts, mine water discharge, and potential coal development drilling.

Modification of Federal Coal Lease U-63214 (Quitcupah Lease)

Canyon Fuel submitted the 150-acre coal lease modification application to BLM on January 12, 1998. The proposed Lease Modification Area lies along the north boundary of the Quitcupah Lease and the SUFCO Mine Permit Area. The application would be evaluated under the procedures set forth in 43 CFR 3432. The subsequent permitting action (Incidental Boundary Change) to allow mining in the modification area would be evaluated by the Utah Division of Oil, Gas and Mining (UDOGM) under procedures set forth in 30 CFR 700 et. seq., requiring a PAP revision to the SUFCO Mine Permit, and approval by Office of Surface Mining, Reclamation and Enforcement requiring a modification to the approved federal mining plan.

The purpose of the modification is to add 150 acres of unleased Federal coal lands to the existing lease and SUFCO Mine Permit Area to maximize recovery of the reserves. If the modification is not approved, the area could be added to the Pines Coal Lease Tract but would probably yield less coal as it may not be conducive to longwall mining. This is due to the small size and configuration relative to the remainder of the Pines Coal Lease Tract. It would probably be mined using the room-and-pillar method that yields less recovery.

If not mined in association the Quitchupah Lease or Pines Coal Lease Tract, this coal would mostly be bypassed since it is cut-off physiographically from the Muddy Creek Tract by Box and Muddy Canyons.

SUFCO Mine Permit Application Package Amendment to Longwall Mine and Subside Box Canyon

Canyon Fuel submitted a PAP amendment to UDOGM on January 19, 1998 (revised May 13, 1998) proposing to subside Box Canyon and the associated perennial drainage using the full-extraction longwall mining method. A lease stipulation and the SUFCO Mine Permit currently prohibit subsidence of Box Canyon to protect the perennial drainage and surface resources.

The PAP amendment area lies at the head of Box Canyon within the existing Quitchupah Lease and SUFCO Mine Permit Area. The purpose of the amendment is to extend an approved longwall panel to the north to maximize coal recovery from the existing lease. It would also allow access to the proposed Lease Modification Area. If not approved, the Lease Modification Area could be accessed by full-support gateroads under Box Canyon (tunnels that would not subside) that would allow longwall mining of the modification area.

III. REASONABLY FORESEEABLE DEVELOPMENT

In order to consider potential effects of implementation, Reasonably Foreseeable Development Scenarios or conceptual mine plans were developed to serve as the basis for the effects analysis. A scenario for each of the three project components is presented below. The scenarios assume that all of the recoverable coal reserves in the tract would be mined by the most efficient method of employing a combination of longwall and room-and-pillar development.

Pines Coal Lease Tract

Two potential scenarios are possible since the tract, if approved for leasing, would be offered for competitive bid. Either the proponent, Canyon Fuel or another company, could obtain the tract through the bidding process.

Once the tract is leased, the lessee/operator would submit a PAP to UDOGM proposing to mine the lease. At that time, UDOGM would start the permit evaluation process in accordance with the Utah Coal Rules as provided under Surface Mining and Control and Reclamation Act and implementing rules and regulations.

The Pines Coal Lease Tract, with an estimated 71 million tons of recoverable coal reserves, could support continued mining for 15 years to 20 years. Impacts common to both development scenarios include mining-induced subsidence (estimated to be 4 to 5 feet for most of the tract and associated surface cracking), a breakout (opening at the coal outcrop) in the Box Canyon/Muddy

Creek Canyon area, surface disturbance for exploration activities, and mine water discharge to Link Canyon and Box Canyon/Muddy Creek.

Construction of a breakout (opening at the coal outcrop) for ventilation, emergency escape, and mine water discharge may be necessary in the Box Canyon/Muddy Canyon confluence area as mining develops. The construction of a breakout would take place from inside the mine, eliminating the need for surface access to the site.

In addition to mining, the Reasonably Foreseeable Development Scenarios assumes that the lessee/operator would conduct additional exploration drilling (approximately 10 holes) in the area of the Pines Tract Project Area. Additional exploration would allow better delineate coal reserves to the northern and eastern portion of the Pines Tract Project Area. Disturbance associated with exploration drilling would encompass less than 40 acres, depending upon the amount of new access roads to be constructed. The roads and pads would be reclaimed as soon as possible after completion and would present only a short-term disturbance. Reclamation and revegetation of disturbed areas in the Quitchupah/Pines area have been very successful. Revegetation of the disturbed areas is generally achieved within 3 years to 5 years of reclamation. The revegetated areas are usually not discernible to the casual visitor beyond this time.

Mine water discharge to Link Canyon would be needed for at least 3 years, or until main entries could be developed to the north to the proposed breakout in the Box Canyon/Muddy Creek Canyon area. Discharge to Box Canyon/Muddy Creek would require specific approval from the State of Utah according to antidegradation rules. Discharge into Link Canyon would be approximately 1,000 gallons per minute. Mine water would be pumped up dip to this discharge point until the Muddy Creek breakout is completed and the proper permits are obtained.

Assuming Canyon Fuel obtains the Pines Coal Lease Tract, the area would be mined using underground mining methods including a combination of the longwall and room-and-pillar methods initiating from underground workings in the existing SUFCO Mine Permit Area. The existing portal facilities in Convulsion Canyon on the Fislake National Forest would be used. Enlargement of the facilities in Convulsion Canyon is not anticipated. It is assumed that all coal would be hauled along existing haul routes from the SUFCO Mine. Haulage traffic would be increased proportionate to projected production increases. The SUFCO Mine production could increase from 5.9 million tons annually to 6 to 9 million tons annually.

Mine water discharge would be conveyed via a 15-inch Drisco (plastic) pipe from a Link Canyon breakout that would drain to the south, contouring the west slope of Link Canyon (a distance of 1,500 feet), to the FS boundary where it would be discharged into Link Canyon Wash. A trench and bench would be constructed to bury the pipe.

Should another company be the successful bidder for the Pines Coal Lease Tract, it would access the tract from the coal outcrop in Link Canyon, requiring development and construction of new

mine facilities in Link Canyon and reconstruction of the Link Canyon road from SR-10 to the mine site in Link Canyon. Including the existing disturbance from the current road and abandoned Link Canyon Mine, approximately 100 acres could be disturbed for this development. The mine would be similar to the adjacent SUFCO Mine, have similar operating costs and would be in competition; however, start up costs for initial construction of mine facilities would be an additional cost incurred.

Mine water discharge to Link Canyon would likely entail placing a plastic discharge pipe under or adjacent to the access road. The pipe would extend approximately 2,500 feet to the Forest Boundary.

Lease Modification (Add 150 acres to the Quitchupah Lease U-64213)

If the modification and PAP amendment are both approved, Canyon Fuel would extend an already approved longwall panel further northward into the Lease Modification Area. Subsidence would be similar to that discussed above.

If the PAP amendment (described below) is not approved and Canyon Fuel is unable to extend the panel under Box Canyon, the Lease Modification Area could be mined by extending full-support (no subsidence) longwall development entries (gateroads) under Box Canyon to access the modification area. The modification area could then be mined using longwall extraction.

If the PAP amendment is not approved and/or Canyon Fuel withdraws their lease modification application, the 150-acre modification area could be added to the Pines Coal Lease Tract. Under this scenario, the modification area would most likely be mined using the room-and-pillar method with secondary pillar recovery. The modification area would most likely not be mined using the longwall method because of the small size and orientation.

Permit Application Package Amendment to Subside Box Canyon

This action is specific to Canyon Fuel because the area already lies within the SUFCO Mine Permit Area. Canyon Fuel has proposed to extend the already approved longwall panel in the Quitchupah Lease northward under Box Canyon. This would cause subsidence of the associated escarpment and perennial drainage.

IV. DECISIONS TO BE MADE BY THE RESPONSIBLE OFFICIALS AND AUTHORITY

Pines Coal Lease Tract and Modification to U-64213 (Quitchupah Lease)

The Utah State Director of BLM must decide whether or not to approve the Pines Coal Lease Tract for leasing and whether or not to modify Federal Coal Lease U-63214 as proposed under authority of the Mineral Leasing Act of 1920, as amended, and enacting Federal regulations contained in 43 CFR 3400 et. seq.

The Forest Supervisor, MLS, must decide whether or not to consent to leasing of the Pines Coal Lease Tract and modification U-63214 by BLM and under what conditions are needed to protect non-mineral resources. Consent by the Surface Management Agency (Forest Service in this case) and measures for protection of non-mineral resources are required under authority of the Federal Coal Leasing Amendments Act of 1975 that amended the Mineral Leasing Act of 1920. By virtue of this decision, the Forest Supervisor would also be consenting/concurring to underground mining consistent with the impact analysis for the lease.

Permit Application Package Amendment to Subside Box Canyon

The BLM State Director must decide whether or not to make an exception to the lease stipulation that prohibits subsidence of Box Canyon by specific approval of a minor mine plan amendment and to recommend approval of the corresponding PAP amendment to the Director, UDOGM.

The Forest Supervisor, MLS, must decide whether or not to consent/concur to approval of the PAP amendment by the Director, UDOGM and under what conditions for protection of non-mineral resources.

V. ISSUES

The environmental analysis documented in this EIS is driven by the identified issues. The issues were identified for analysis through the project scoping process that includes extensive public involvement and cooperation from participating agencies. A Notice of Intent (NOI) to prepare the EIS was published in the Federal Register January 29, 1998 and an amended NOI was published on April 14, 1998. A public scoping letter requesting comments and issues was sent to 132 individuals and organizations on February 3, 1998. Corresponding public (legal) notices were published in the Sun Advocate newspaper (publication of record) and supplemental publications (Emery County Progress and Richfield Reeper). A discussion of responses and comments received is contained in Chapter 2 of the EIS. The issues identified for analysis are as follows:

Topography, Geology, and Subsidence

Mining activities associated with the proposed analysis area could result in subsidence-induced ground movements, changes in geology and topography, and escarpment failures.

- Areas of geological interest, such as natural bridges, escarpments, arches, and alcoves could be disturbed from subsidence.

Hydrology - Groundwater

Mining activities associated with the proposed analysis area and associated subsidence-induced ground movements could interrupt or degrade groundwater within or adjacent to the lease tract. Groundwater quality and quantity, and how these variables affect vegetation, wildlife, livestock,

water rights, and future water sources, were underlying themes of many of the comments received.

- Groundwater within the Project Area supports flows to springs, riparian areas, and wetlands. Groundwater may be interrupted due to subsidence-induced ground movements and fracturing of the strata. This interruption of groundwater could result in a reduction in surface acreage of riparian areas and/or wetlands within the Project Area. This interruption could also result in impacts to livestock and wildlife that are seasonally supported by the springs in the area.
- Groundwater and surface water rights could be negatively impacted as a result of interruption of groundwater.
- Mine equipment could be left underground after mining activities have been completed, which could have the potential to degrade groundwater quality.
- Subsidence could alter shallow aquifers which could be used as groundwater sources.

Hydrology - Surface Water

Mining activities associated with the analysis area and associated subsidence-induced ground movements could result in impacts (either reduction in flows or elimination of water source) to surface drainages, riparian areas, wetlands, and springs. Changes in flow could alter the riparian vegetation, available water to livestock and wildlife, and wildlife habitat. Discharges from the mine could degrade water quality and flows of Muddy Creek, Link Canyon, Quitchupah Creek, if discharge continues. If a new mine is developed in Link Canyon, sediment/other contaminants could be introduced to Link Canyon.

- The Project Area contains several perennial streams, springs, riparian areas, and wetlands. These springs, riparian areas, and wetland areas are supported by groundwater sources. Subsidence or other mining operations could divert water supplying these areas.
- The Muddy Creek provides drinking water and secondary irrigation water to the Town of Emery. There is a concern that mining within the Project Area would have an impact upon water quantity and water quality of Muddy Creek. The environmental analysis should review cumulative and incremental mining impacts to water resources.
- Should another company obtain the lease and develop a mining operation at Link Canyon (or another location), increased surface disturbance has the potential to

increase erosion, and hence sediments in surface drainages, and other surface related pollutants.

- The proposed project is within the Colorado River Basin. As such, there is the potential that the proposed project could result in impacts to special status species found in the Colorado River and its tributaries. Changes in flow (increase or decrease) and water quality could modify the habitat for these species.
- Escarpment failures and subsidence could alter the course and/or grade of surface drainages within the Project Area.
- Increases or decreases in surface water flows may result in impacts to water rights and water availability for livestock and wildlife uses (stock watering ponds).
- Underground mining may cause transbasinal diversions of intercepted (and then discharged) groundwater within watersheds and subwatersheds. Groundwater intercepted is either used in the mine underground, or discharged from the workings. There was concern that water intercepted underground may be discharged into a watershed other than the watershed for which it was originally destined.

Vegetation

Mining activities associated with the analysis area and associated subsidence-induced ground movements could result in impacts to riparian areas, wetlands, springs, and the unique vegetation of the escarpments. Areas exhibiting subsidence could also result in impacts to timber resources. Surface disturbance could also create direct impacts to vegetation. Construction of a new mine in Link Canyon could remove approximately 100 acres of vegetation.

- Subsidence-induced ground movement could alter groundwater flows to riparian areas, wetlands, and springs. The vegetation associated with these areas could be altered by reduced flows.
- Escarpment failure could result in the loss of the unique vegetation found where groundwater seeps out of the escarpments.
- Timber resources could be impacted through construction of new surface facilities.
- New surface disturbance associated with proposed mining has the potential to encourage the invasion of noxious weeds and/or exotic plants.

- Mining-induced subsidence and surface disturbance associated with mining has the potential to impact threatened and endangered species or their habitat within the analysis area.

Wildlife

Mining activities associated with the analysis area and associated subsidence-induced ground movements could indirectly result in impacts to wildlife. These include loss of riparian habitats, loss of available water, loss of upland/escarpment habitats, changes in wildlife diversity, and alteration of movement patterns. Direct losses due to wildlife-vehicle interactions are also likely to increase. If new surface facilities are developed, habitat losses would occur.

- Mining activities and associated subsidence-induced ground movements could result in impacts to perennial streams, riparian areas, wetlands, and springs (either reduction in flows or elimination of water source). Potential impacts could occur to vegetation and forage production, sage grouse lek areas, big game winter and transitional ranges, and wildlife migrational routes.
- Coal haulage has the potential to increase deer/elk vehicle-related mortality due to increased coal production and the increased time period over which mining would occur.
- Subsidence-induced ground movements associated with underground mining activities could alter habitat for wildlife. Specifically raptor nesting (e.g., peregrine falcon and goshawk) and bat roosting habitat could be lost due to escarpment failures.
- Mining activities could result in impacts to the Western blue bird through loss of nesting habitat. Subsidence-induced ground movements could disrupt forest habitat, or disruption of flow to riparian habitats could result in a loss of aspen. The Western blue bird may be highly localized to the area and negative impacts could have the potential to significantly impact the whole population.
- Mining-induced subsidence and surface disturbance associated with mining has the potential to impact threatened and endangered species or their habitat within the Pines Tract Project Area.
- Habitat losses would be associated with potential new surface facilities.

Cultural and Paleontological Resources

Cultural and paleontological resources could be impacted by mining related activities and subsidence-induced ground movements, and by the construction of a new mine in Link Canyon.

- Construction of surface facilities and subsidence-induced events, such as seismic events, cracks, changes to topography, and escarpment failures, or groundwater discharge could affect significant archaeological, paleontological, and historical resources.

Land Use

Approval of the proposed lease actions may result in impacts to land uses within the area (e.g., existing and future surface development and/or other lessees).

- Subsidence-induced ground movements, whether resulting from operations at the SUFCO Mine or Link Canyon Mine, could damage surface structures such as roads, pipelines, power lines, stockponds, developed springs, other facilities, and survey monuments.
- Approval of the Pines Tract Project and associated mining need to be compatible with multiple-use of public lands and should be consistent with Federal, State, and local land use policies.
- Coal leasing could conflict with oil and gas/leasing, exploration, and production.

Recreation

Approval of the proposed lease actions and proposed subsidence of Box Canyon could result in degradation of the recreation experience.

- Mining related activities and associated subsidence-induced ground movements could result in impacts to the recreational experiences in the Pines Tract Project Area.
- Effects of the proposed action in roadless areas need to be considered.
- Construction of a new mine in Link Canyon and reconstruction of the Link Canyon road could affect recreation access to the Pines Tract Project Area.

Public Safety

Approval of the proposed lease actions and operations could create potential hazards to public safety.

- Mining-induced subsidence could result in escarpment failures (i.e. falling rocks), which could affect public safety.
- Existing roads could be impacted as a result of escarpment failures and subsidence-induced ground movements.

- Increased production and extension of haul traffic into weekends could increase the potential for traffic accidents. The increased duration of haul traffic could also extend this impact to the end of mine life.
- The operation of a new mine in Link Canyon could result in increased coal hauling on SR-10 and through local communities and an increased amount of accidents.

Range/Livestock

Livestock distribution is a function of available forage and water distribution. Livestock trailing is also conducted within the proposed Pines Tract Project Area.

- Subsidence-induced ground movements and surface cracks could alter water supplies and distribution of water on the Project Area.
- Subsidence-induced ground movements and surface cracks could damage surface structures such as fences, troughs, pipelines, other range improvements, and interfere with trailing routes.
- Construction of new facilities, especially haul roads, could impact trailing of livestock during specific periods of the year in Link Canyon.

Visual Resources

Mining activities, including surface facilities, and escarpment failures could impact visual quality of the area.

- Mining-induced subsidence could result in escarpment failures, which may lead to alterations in the natural topography and visual quality.
- Construction of surface facilities could alter the visual aspect of the area.

Noise

Mining activities include the use of heavy equipment, conveyors, and haul trucks which all generate noise.

- Approval of the proposed lease actions could result in continued and increased amounts of human-generated noise from the breakout in Muddy Creek and/or in Link Canyon if a new mine is developed.

Transportation and Engineering

Increased coal production could result in increased haulage needs. The extension of mining activities could result in haulage traffic for a longer period of time. A new mine in Link Canyon would result in hauling coal down Link Canyon road to SR-10.

- Increased haulage could increase road damage and maintenance costs.
- Increased haulage could conflict with design traffic levels on haul routes, resulting in additional accidents.
- Subsidence could alter existing roads within the Project Area.
- A new mine in Link Canyon would require reconstruction of the Link Canyon road and potentially interfere with existing access to the Pines Coal Lease Tract.

Socioeconomics

Approval of the proposed lease actions and mining operations has social and economic impacts on the local and regional communities. The different alternatives to be developed for the lease action will have different potential coal recovery amounts.

- Continued coal mining provides economic benefits such as employment, royalties, income, and tax revenues on a local and regional level.
- The approval of the proposed lease actions and mining operations could result in a loss of value for the public as ownership in regard to future types of development opportunities.
- Continued coal mining provides for the increased recoverability of Federal coal reserves.

VI. ALTERNATIVES ADDRESSED IN THE EIS

The formation of alternatives was guided by the issues, purpose and need, postmining land use objectives of the Forest Plan, and the need to comply with Federal, State, and local laws, regulations, and policies. Alternatives were also developed to comply with the requirements of the National Environmental Policy Act (NEPA) to analyze a reasonable range of alternatives. Alternative B was identified and analyzed as a means to display the effects of leasing/mining with no special measures for the protection of non-mineral interests and show the need for such measures to comply with Federal, State, or local laws, regulations, and policies. Consideration was given to avoidance and/or minimization of effects to water (surface and groundwater), special status species, wildlife, unique vegetation or vegetation which exist in limited quantities, public safety, and range/livestock. The steep natural terrain within and surrounding the mine area limits the options available for locating roads and other surface facilities.

Because of the numerous potential combinations of protection measures involved with the required decisions and complexity of displaying effects of each potential combination, the FS decided to

display these possibilities by analyzing four alternatives. These alternatives encompass the complete spectrum of possible decisions that range from no leasing/mining through mining all recoverable reserves with no special stipulations for the protection of non-mineral interests. This allows the responsible officials to select portions of the alternatives in their respective decisions as needed to protect specific areas and resources.

Alternative A No Action Alternative/No Lease Alternative/No Subsidence of Box Canyon

The No Action Alternative is required by CEQ 40 CFR Part 1502.14(d). None of the three proposed actions would be implemented and no mining would take place within the Pines Coal Lease Tract or Lease Modification Area. Mining would be conducted in a manner to prevent subsidence under Box Canyon as specified in the lease stipulation and previously approved under the mine permit.

None of the environmental and socioeconomic effects or economic benefits identified in the other three action alternatives would occur.

Alternative B Lease the proposed areas with Standard BLM Lease Terms and Conditions (No special lease stipulations would be attached to the lease)

This alternative addresses only the leasing proposals for the Pines Coal Lease Tract and Lease Modification Area. The decision regarding the PAP amendment proposing to subside Box Canyon is not addressed since it is already addressed under the Quitchupah Lease. The PAP amendment is covered under the other three alternatives.

The leases would be issued with no Special Coal Lease Stipulations (SCLSs) for protection of non-mineral interests. They would be issued with Standard BLM Lease Terms and Conditions only (Form 3400-12, EIS Appendix C). This alternative is for analysis purposes only and is not consistent with the Forest Plan. This alternative is intended to provide the basis for including the SCLSs for the protection of non-coal resources. The SCLSs would be added to the other alternatives as a means of avoiding or mitigating impacts consistent with the Forest Plan and applicable laws and regulations. The scenario for this alternative assumes that all minable coal would be recovered to the fullest extent using currently accepted industry practices.

Alternative C Lease the proposed areas with Standard BLM Lease Terms and Conditions, and Special Coal Lease Stipulations for Protection of Non-Coal Resources (which would not allow subsidence of escarpments and perennial drainages in the analysis area)

This alternative addresses application of the Standard BLM lease terms and conditions, and the application of SCLSs for the protection of non-coal resources. Specifically, this alternative addresses issues identified through the application of the 18 SCLSs presented in the Forest Plan that are designed to mitigate anticipated environmental effects. Additional stipulations regarding maximum recovery of reserves and abandonment of equipment underground would also apply.

NOTE

This alternative applies to the entire analysis area. The proposed PAP amendment to subside Box Canyon would not be approved.

This alternative assumes that the successful applicant would conduct full-extraction longwall mining for the majority of the Pines Coal Lease Tract. However, mining that would cause subsidence would not be allowed under perennial drainages (Box Canyon, East Fork of Box Canyon) or escarpments (Link Canyon, Box Canyon, East Fork of Box Canyon, and Muddy Creek, including Wiley's Fork).

This alternative would involve mining of the 7,311- acre Pines Coal Lease Tract, and within a 150-acre Lease Modification Area to the Quitchupah Lease. It represents an alternative that provides for mining of the tracts with maximum protection measures to assure consistency with applicable laws and regulations and Forest Plan objectives for protecting ecosystems.

Alternative D Lease the proposed areas with Standard BLM Lease Terms and Conditions, and Special Coal Lease Stipulations for Protection of Non-Coal Resources, allowing subsidence of perennial drainages and escarpments in the analysis area

Alternative D includes all considerations of mining as described in Alternative C, but includes mining that would allow subsidence of perennial drainages and escarpments as long as it would be consistent with laws, regulations, and Forest Plan direction. It would involve approval of the PAP amendment to subside Box Canyon. This alternative includes full-extraction longwall mining under perennial drainages and escarpments within the analysis area. Specifically, this alternative allows mining under perennial drainages in Box Canyon, the East Fork of Box Canyon, as well as under escarpments in Box Canyon, East Fork of Box Canyon, Link Canyon, and the Muddy Canyon, including Wiley's Fork. Current SCLS #13 on the Quitchupah Lease states that "except at specifically approved locations, underground mining operations shall be conducted in such a manner so as to prevent surface subsidence that would cause the creation of hazardous conditions such as potential escarpment failures and landslides, ..., and damage or alter the flow of perennial streams".

Other SCLSs would be applied, requiring monitoring and mitigation of impacts.

VII. EFFECTS OF IMPLEMENTATION

The following is a brief summary of the potential effects of each alternative discussed in detail in Chapter 3 of the EIS. Table ES.i shows specific effects by issue/evaluation criteria in a comparison of the alternatives.

Table ES.i Comparison of Alternatives

Resource Element/Issue	Alternative			
	A	B	C	D
GEOLOGY, TOPOGRAPHY, SUBSIDENCE:	No Effect	Up to 19.8 linear miles of escarpment could be subsided. Failures would likely occur in < 100 feet segments at isolated locations. Approx. 5 feet vertical subsidence. Arches & alcoves could be disturbed from subsidence.	No escarpments would be subsided, therefore no risk for failure or damage to alcoves or arches. Approx. 5 feet vertical subsidence. SCLS implemented.	Same impact as Alternative B; however, up to 22.5 linear miles could be subsided.
GROUNDWATER HYDROLOGY:	No Effect	Low to moderate potential to alter recharge paths to springs either causing flow increases or decreases. Low potential to affect water quality. Low potential for trans-basin diversion.	Reduced potential to alter springs since no subsidence of Box Canyon or East Fork. All else same as Alt. B. SCLS would require water replacement.	More springs could be subsided with low to moderate potential for altering recharge paths. All else same as Alt. B. SCLS would require water replacement.
SURFACE HYDROLOGY:	No Effect	High risk of diverting stream flow underground at Confluence Area - Main Fork. Moderate to high risk of intercepting flow in Upper East Fork Box Canyon. Moderate potential to crack and drain stock ponds. Inconsequential trans-basin diversions. Minimal water quality impacts.	No risk of diverting or intercepting stream flow. All else is same as Alt. B. SCLS would require water replacement.	Impacts to streams would be same as Alt. B but would include moderate to high risk of interrupting stream flows in Box Canyon. All else is same as Alt. B. SCLS would require water replacement.

Table ES.i Comparison of Alternatives (cont.)

Resource Element/Issue	Alternative			
	A	B	C	D
SOILS:	No Effect	40 acres short term disturbance to soils from exploration; If a new mine is developed in Link Cyn, 100 additional acres of long-term disturbance to soils.	Similar impact as Alt. B. SCLS would be implemented, long term disturbance areas would be reclaimed upon cessation of mining to pre-mining land use.	Same impacts as Alternative B and C. SCLS would be implemented.
WILDLIFE:	No impacts associated w/ coal mining. Winter range for elk and mule deer could improve. Some species could benefit from vegetation treatments.	Loss of water in streams, springs or ponds, could alter riparian habitat important for sage grouse and macroinvertebrates, and reduce availability of live water sources for wildlife. Surface disturbance could remove 5 percent big game winter range. Escarpment failure could alter eagle and falcon nest locations. Up to 40 acres short-term habitat disturbance from exploration drilling.	Reduced potential for altering riparian habitat in perennial drainages. No risk to eagle or falcon nests. All else same as Alt. B.	Increased potential to lose water supporting riparian habitat in perennial drainages, thus increasing potential to reduce sage grouse and macroinvertebrate habitat. Increased risk to depleting live water sources.

Table ES.i Comparison of Alternatives (cont.)

Resource Element/Issue	Alternative			
	A	B	C	D
VEGETATION:	Changes would result from actions taken to meet allotment management goals for livestock and wildlife.	Potential loss of 18.9 acres wetland/riparian vegetation and associated aquatic habitat; 40 acres short-term impact to other vegetation communities from exploration activities. If a new mine is developed in Link Cyn, 100 acres of long-term impact to vegetation.	SCLS would apply and would reduce potential impact to vegetation. Water sources lost would be replaced. Approx. 3 acres wetland/riparian habitats potentially impacted. Surface disturbance the same as Alt B, but would be reclaimed.	SCLS would apply, providing mechanism to protect wetland resources. Water sources lost would be replaced. Potential to impact 24.16 acres wetland/riparian vegetation. Surface disturbance the same as Alt C.
SPECIAL STATUS SPECIES:	No Effect	May affect- NLAA-Peregrine falcon, Colorado River fish species. May impact spotted bat, northern goshawk, flammulated owl, northern three-toed woodpecker. Will impact link trail columbine.	May impact northern three-toed woodpecker, link trail columbine. SCLS implemented, eliminate/reduce potential for impacts to these species.	Same impacts as Alt B. SCLS implemented, eliminate/reduce potential for impacts to these species.

Table ES.i Comparison of Alternatives (cont.)

Resource Element/Issue	Alternative			
	A	B	C	D
LAND USE AND RECREATION:	Continued operation of SUFCO Mine. No new impacts.	New mine at Link Cyn could hinder recreational access. Low probability of injury to public land users due to escarpment failure. Future oil and gas leases could conflict with existing coal leases.	Reduction in impacts as Alternative B. SCLS applied. New mine at Link Cyn could hinder recreational access. No potential impact to public land users due to escarpment failure. Future oil and gas leases could conflict with existing coal leases.	Same impacts as Alt. B and C.
CULTURAL RESOURCES:	No Effect resulting from mining related actions; however, potential impacts may occur from recreational and livestock activities.	Six National Register eligible/unevaluated cultural resources could be affected by Level III or greater impacts.	None of the National Register eligible/unevaluated sites will be impacted by Level III or greater impacts.	Nine National Register eligible/unevaluated sites could be affected by Level III or greater impacts.
VISUAL RESOURCES:	No Effect	Potential for 19.8 miles of escarpment failure. Up to 40 acres surface disturbance resulting from exploration. If a new mine is developed in Link Cyn, up to 100 acres long-term surface disturbance.	No potential for escarpment failure. Up to 40 acres surface disturbance resulting from exploration. If a new mine is developed in Link Cyn, up to 100 acres long-term surface disturbance.	Potential for 22.5 miles of escarpment failure. Up to 40 acres surface disturbance resulting from exploration. If a new mine is developed in Link Cyn, up to 100 acres long-term surface disturbance.

Table ES.i Comparison of Alternatives (cont.)

Resource Element/Issue	Alternative			
	A	B	C	D
AIR QUALITY:	The rate/impact of pollutants from SUFCO Mine would decrease to zero impacts when recoverable coal supply is depleted, year 2014.	Moderate increase in fugitive dust emissions. Increase in PM-10. Increase in particulate impact from loading.	Air pollution emission impact same as Alternative B, except for fugitive dust mitigative measures (SCLS) apply and impact would for a shorter duration (1 year less for Cyn Fuel/ 2 years for another mine).	Air pollution emission impacts similar as Alternative C.
SOCIOECONOMICS:	\$1.49 billion in coal value not realized. 230 jobs lost when SUFCO Mine closes in 14 years.	74.4 million tons coal recoverable. \$1.49 billion coal value realized. \$119 million government revenues.	64.5 million tons coal recoverable. \$1.29 billion coal value realized. \$103.2 million revenue.	76.6 million tons coal recoverable. \$1.53 billion recoverable coal, \$122.6 million in govt revenues.
TRANSPORTATION:	Haul traffic from SUFCO Mine would continue for 14 years at current rate.	Increase in truck traffic volumes. Surface related impacts to FS roads resulting from exploration activities (40 acres). Improvement of either Convulsion Cyn Road or Link Cyn Road.	Same impacts as Alt B, except truck traffic occurs for shorter duration. (1 year less for Cyn Fuel/ 2 years less for another mine).	Same impacts as Alt B, except truck traffic occurs for longer duration-2 years

Table ES.i Comparison of Alternatives (cont.)

Resource Element/Issue	Alternative			
	A	B	C	D
RANGE:	Allotment managed according to AMP with emphasis on increasing forage, maintaining wildlife habitat, and implementing approved range improvements. No ponds have potential for impact.	Possible reduction of water available for livestock, possible reduction of AUMs for 1 to 5 years. Potential to block/restrict access to existing livestock trailing route. 9 ponds have potential for impact.	Similar impacts as Alt B except SCLS apply. Potential to block existing livestock routes. Possible reduction of AUMs from either exploration and/or new mine. 9 ponds have potential to lose water, replacement would be required.	Same impact as Alt C. SCLS apply. Potential to block existing livestock routes. Possible reduction of AUMs from either exploration and/or new mine. 9 ponds have potential to lose water, replacement would be required.

Alternative A No Action Alternative/No Lease Alternative/No Subsidence of Box Canyon

This alternative represents the maximum surface resource protection end of the alternative spectrum.

Under this alternative there would be no mining within the tract boundaries and the PAP amendment would not be approved. The associated environmental impacts would not occur. Conversely, there would be no associated energy production and economic benefits. The SUFCO Mine would deplete existing reserves and close down in approximately 10 years to 15 years. The recoverable coal reserves in the proposed lease areas would not be mined from the existing operations at the Quitcupah Lease but could conceivably be mined sometime in the future via access from the coal outcrop in Link Canyon. The coal reserves not recovered due to denial of the PAP amendment would be irreversibly lost due to current technology limitations.

Alternative B Lease the proposed areas with Standard BLM Lease Terms and Conditions (No special lease stipulations would be attached to the lease)

This alternative represents the maximum coal development/greatest environmental impact end of the spectrum of alternatives.

It involves maximum coal production by allowing full-extraction of the reserves using standard industry practices. In addition, no SCLSs would be included on the lease areas for the protection or mitigation of non-coal resources.

Even though the requirements of Surface Mining and Control and Reclamation Act and the coal mine permitting regulations would apply at the time of mine permitting, it is assumed in this alternative that mitigations normally provided by SCLSs would not occur. This alternative and associated assumptions were included for analysis purposes to display the impacts of not applying the SCLSs for comparison with Alternatives C and D which include SCLSs. It would not be consistent with Forest Plan requirements.

Alternative C Lease the proposed areas with Standard BLM Lease Terms and Conditions, and Special Coal Lease Stipulations for Protection of Non-Coal Resources (which would not allow subsidence of escarpments and perennial drainages in the analysis area)

This alternative represents a middle-ground situation that would allow leasing of the proposed areas and mining with SCLSs and provides full protection of the sensitive perennial streams and escarpments by not allowing them to be subsided. Under this alternative, the PAP amendment proposing subsidence of Box Canyon would not be approved.

The recoverable coal reserves that could be mined and the associated energy production and economic benefits would be less than Alternatives B and D but would be more than Alternative A (No Action). The sensitive areas would be protected and mitigation of effects that occur would

be required. This alternative fully meets Forest Plan objectives and prescriptions with minimal risk to these areas and resources.

Alternative D Lease the proposed areas with Standard BLM Lease Terms and Conditions, and Special Coal Lease Stipulations for Protection of Non-Coal Resources, allowing subsidence of perennial drainages and escarpments in the analysis area

This alternative represents another middle-ground scenario that would involve leasing of the proposed areas and approve the PAP amendment that proposes to subside Box Canyon. The recoverable reserves would be mined to the maximum extent using standard industry practices but mitigation of impacts would be required by SCLSs.

Coal recovery and the associated energy production and economic benefits would be similar to Alternative B but additional costs would be incurred by implementation of the mitigations required by the SCLSs. The energy production and economic benefits would be greater than those for Alternative A and C. The effects to other resources would be greater than Alternatives A and C but less than Alternative B, after mitigation.

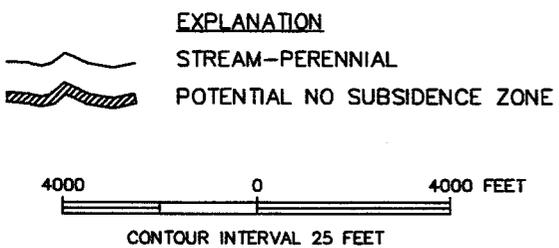
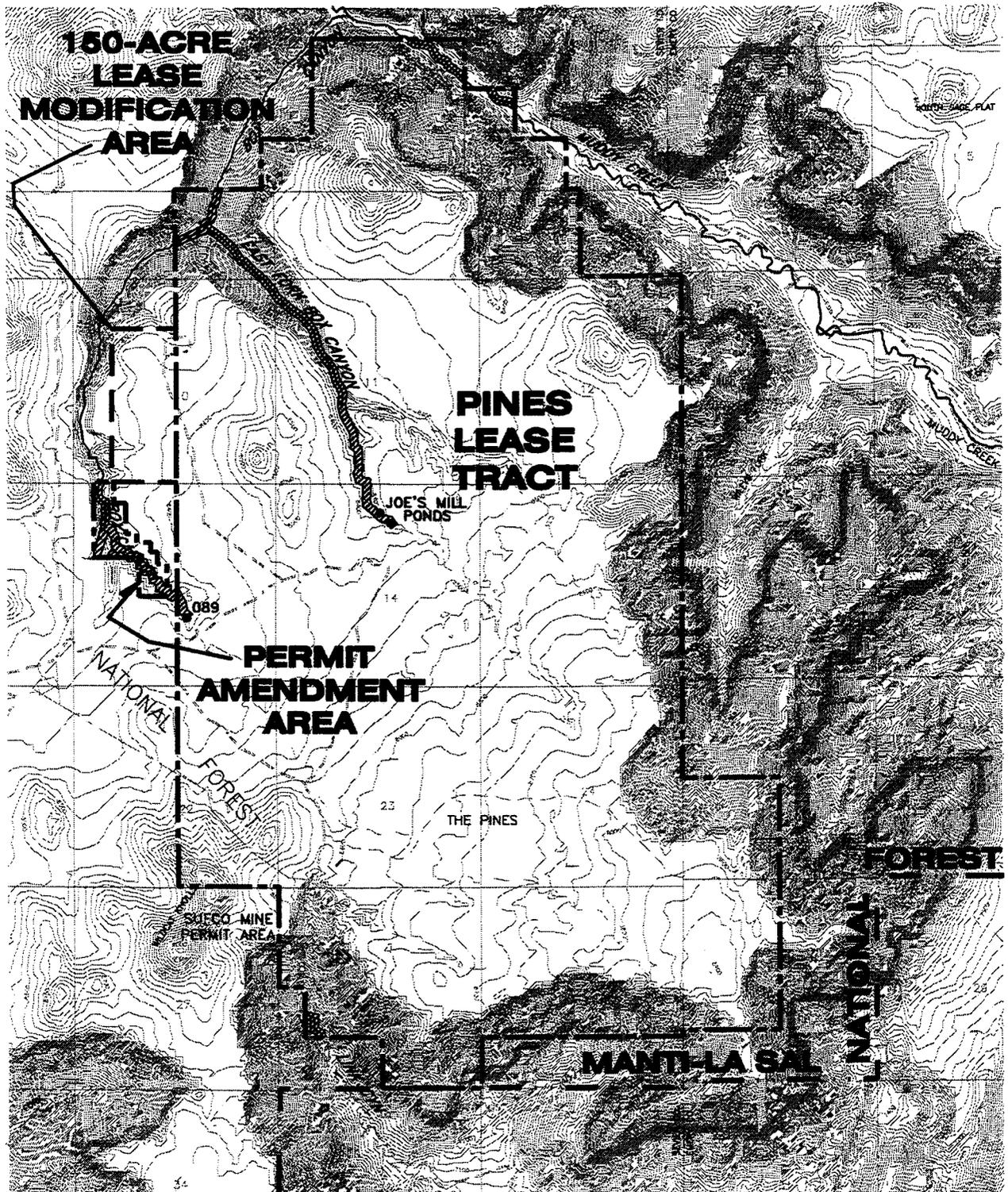
VIII. PREFERRED ALTERNATIVE

The responsible agencies have decided that the Pines Coal Lease Tract and proposed Lease Modification would be offered for leasing with special coal lease stipulations derived in part from the Manti-La Sal Forest Plan. Both Alternatives C and D provide for leasing with special coal lease stipulations, but differ in whether subsidence would be allowed under escarpments and perennial drainages. Since the agencies have decided that protection of some escarpments is necessary, and since Alternative C contains provisions for escarpment protection, the Preferred Alternative can best be described as a modified Alternative C. Protecting escarpments from subsidence afforded under Alternative C would be modified in accordance with the following provision:

Escarpments could be subsided with the exception of the escarpment area (perennial pond/alcove) at the head of Box Canyon in the main fork (location identified as Canyon Fuel's water monitoring point 089). Subsidence of escarpments which contain active raptor nests would be allowed only if a "take permit" is obtained from the U.S. Fish and Wildlife Service. Subsidence of areas containing rock shelters would be contingent upon concurrence of the Utah State Historical Preservation Office (USHPO) and mitigation (excavation/documentation) as agreed upon by the FS, USHPO, and the Advisory Council on Historic Preservation.

However, an issue remains to be resolved related to protecting perennial streams from the potential impacts of subsidence. For this issue, the preferred alternative ranges from Alternative C (not allowing perennial drainages to be subsided), to Alternative D (allowing subsidence to occur with mitigation required to repair any damage to a stream channel which might result from subsidence). The agencies are working to reach a balance of effective protection of perennial stream flows in Box Canyon and its tributaries with the maximum economic recovery of the coal resources. The agencies will continue additional analysis and investigation of this issue during the DEIS public comment period. A final decision regarding the subsidence of perennial drainages (Box Canyon and the East Fork of Box Canyon including the right (southwest) fork which is considered intermittent, but perennially functioning, and Joes Mill Ponds) will be made in the Record of Decision when the Final EIS (FEIS) is completed. Final resolution will be based on a) any new or relevant information provided in the public comments on the DEIS, b) further evaluation of methods and effectiveness of mitigations for potential stream channel damage and flow reduction, and c) further investigation on the economic feasibility of segmenting longwall panels to prevent subsidence of the noted perennial stream reaches.

The effects regarding escarpment failures would be as displayed under Alternative D. The effects regarding perennial drainages would range between those displayed under Alternative C and those displayed under Alternative D. Coal recovery would range from 76.6 million tons identified for Alternative D to 64.5 million tons identified for Alternative C, depending on resolution of the perennial drainage subsidence issue. Figure ES-i presents the preferred alternative.



MANTI-LA SAL NATIONAL FOREST PINES TRACT PROJECT		
FIGURE ES-i PREFERRED ALTERNATIVE		
SCALE 1"=4000'	DATE DRAWN 8/14/98	LAST REVISION 9/1/98

1.0 INTRODUCTION

This environmental impact statement (EIS) considers three separate proposed Federal actions, and is a joint document between the United States Department of Agriculture (USDA), Forest Service (FS), Manti-La Sal National Forest (MLS) and the United States Department of the Interior (USDI), Utah State Office, Bureau of Land Management (BLM). The USDI, Office of Surface Mining, Reclamation and Enforcement (OSM) Western Regional Coordinating Center is participating as a cooperating agency. The three actions are being combined and analyzed under one National Environmental Policy Act of 1969 (NEPA) document because they are occurring at the same time and in the same vicinity, and thus are related in time and space. The actions are combined to encompass the Pines Tract Project Area or "Project Area." This NEPA analysis will consider the potential environmental consequences associated with implementing each of these actions. All three involve Federal coal lands within National Forest System lands administered by the MLS. Each is described below.

The first action is processing Federal Coal Lease Application UTU-76195 (Pines Coal Lease Tract) to lease by competitive bid Federal lands for coal development. The application covers approximately 7,311 acres of National Forest System Lands in the area known as "The Pines", on the MLS. The application was submitted by Canyon Fuel Company, LLC (Canyon Fuel), for their Southern Utah Fuel Company (SUFSCO) Mine.

The second action evaluates an application from Canyon Fuel to modify their existing Quitchupah Lease (U-63214), and add 150 acres of Federal coal reserves that may otherwise be bypassed. This is referred to as the "Lease Modification Area" in the analysis.

The third action considers an application by Canyon Fuel to amend their approved Permit Application Package (PAP or permit) for their SUFSCO Mine and subsidence portions of Box Canyon Creek using full extraction longwall mining methods. Box Canyon Creek lies within Canyon Fuel's existing Quitchupah Lease. Stipulations currently applied to the Quitchupah Lease preclude mining-induced subsidence that would damage or alter perennial drainages. This analysis considers making an exception to the stipulation and giving specific approval to subsidence Box Canyon. This is referred to as the "Box Canyon proposed subsidence area" or the "PAP or Permit Amendment Area" in the document.

Decisions to be made, authorizing actions and a description of the Federal coal leasing process are further discussed in Sections 1.3 and 1.4.

1.1 PURPOSE AND NEED

The purpose of the Federal action is to consider leasing of additional Federal coal lands to allow economic recovery of coal reserves, and to determine the conditions under which the reserves may be recovered to provide for protection of non-coal resources while allowing for optimum economic recovery. The BLM, charged with the administration of the mineral estate on these Federal lands, is required by law to consider leasing Federally-owned minerals for economic recovery. The purpose of the EIS analysis is to evaluate the potential environmental consequences of leasing additional Federal coal lands for underground coal resource development and allowing recovery of additional coal reserves not previously allowed due to other resource concerns.

Canyon Fuel indicated a need for additional coal reserves in order to increase the life of the SUFCO Mine, increase production, remain competitive in the current coal market, and to maintain current coal contracts. Recovering these Federally-owned coal reserves ensures that they will not be bypassed or rendered inaccessible.

Under the Federal Leasing program, the USDI combined major Federal coal management responsibilities into one unified program in order to:

1. Give the nation a greater assurance of being able to meet its national energy objective.
2. Provide a means to promote a more desirable pattern of coal development with ample environmental protection.
3. Assure that State and local governments participate in decisions about where and when Federal coal production will take place.
4. Increase competition in the western coal industry.

The Project Area is available for further consideration for coal leasing as determined by the FS through the analysis and decisions documented in the MLS Land and Resource Management Plan (Forest Plan), Final EIS, and Record of Decision (ROD), 1986. These documents were prepared in accordance with the requirements of the National Forest Management Act of 1976 (NFMA); NEPA; the Mineral Leasing Act of 1920, as amended (MLA); and implementing regulations contained in 43 CFR 3420.1, and all other applicable laws and regulations.

The Project Area lies within the Quitchupah-Pines Area as described in the Forest Plan (Appendix C, page C-9). After completion of the Forest Plan analysis and initial application of the Coal Unsuitability Criteria (43 CFR 3461, Forest Plan Appendix C, page C-1 to 6), it was determined that:

One coal tract, that can be mined from the southern and eastern escarpments (Quitcupah, Dry Fork or Link Canyon), will be available for further coal lease action consideration. Lease Actions for a second tract will be delayed until the first tract has been mined out or when threshold levels are capable of accommodating added mining (Appendix C, page C-9, No. 6).

The decisions of the responsible officials are subject to site-specific application of the unsuitability criteria and site-specific environmental analysis (Appendix C, page C-1). The responsible officials have determined, after review of the referenced planning documents, that the Pines Coal Lease Tract and proposed modification to Federal Coal Lease U-63214 are available for further consideration for leasing (Letter to BLM, Utah State Director, February 23, 1998).

BLM directives indicate the need to offer Federal coal for lease in quantities responsive to demand and market conditions, and assure maximum economic recovery (MER) of minable Federal coal reserves.

The proposed action(s) will conform to the overall guidance of the MLS Forest Plan and Final EIS and the Final EIS for the BLM San Rafael Proposed Resource Management Plan (1992). This EIS tiers to the decisions of both EISs, which are available for review at the MLS Forest Supervisor's Office and the BLM Price River/San Rafael Resource Area Office, both in Price, Utah. The EIS references the environmental assessment (EA) and the Decision Notice and Finding of No Significant Impact (DN/FONSI) for Federal Coal Lease U-63214, Quitcupah Lease, 1988, and the Uinta-Southwestern Utah Coal Region Round Two Final EIS, 1983.

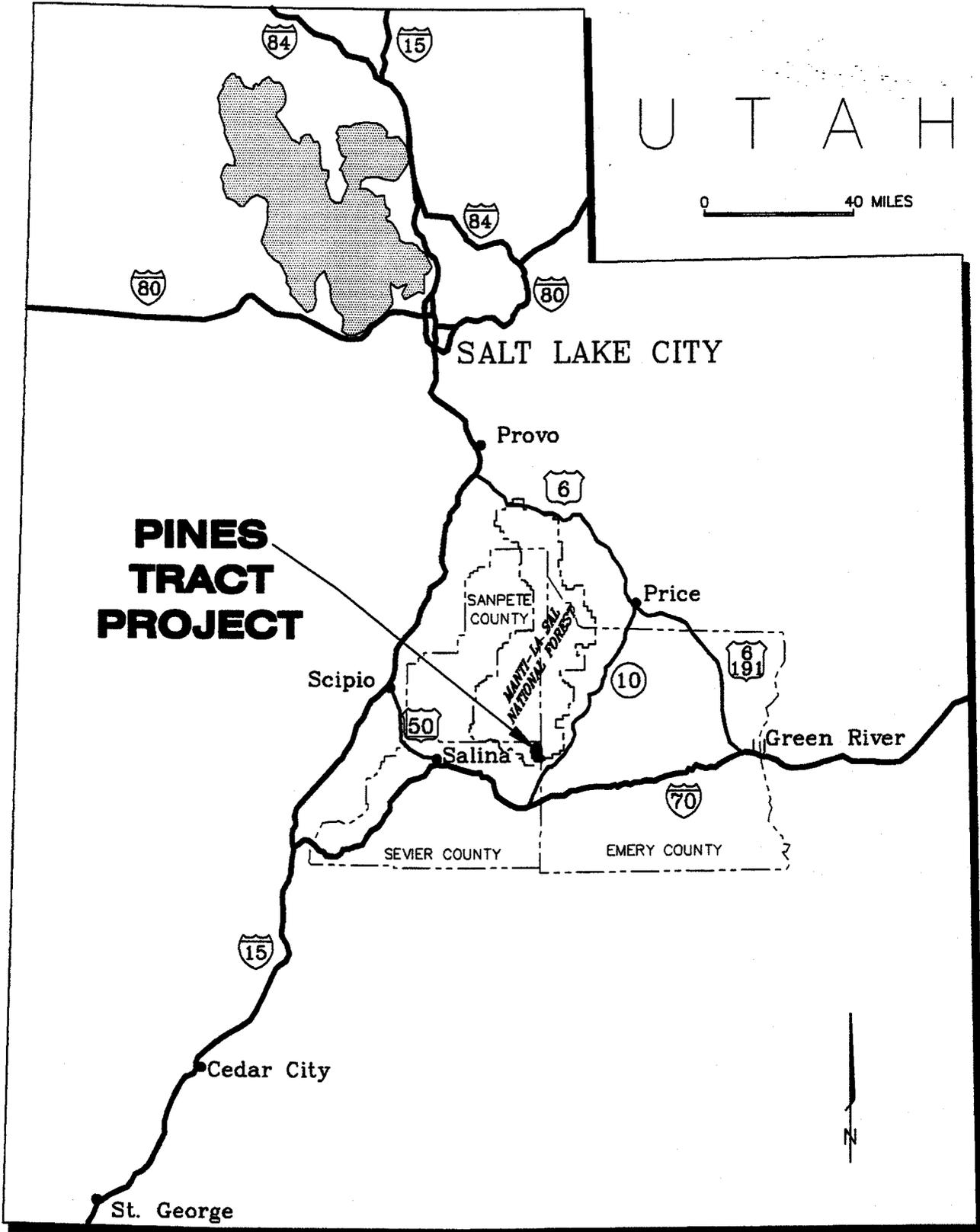
Further discussion on the authorizing actions is given in Section 1.3.

1.2 GENERAL LOCATION

The Pines Tract Project Area lies entirely on National Forest System Lands administered by the MLS, Ferron/Price Ranger District. Figure 1-1 presents the regional project location, and Figure 1-2 presents the general project location. The Project Area is located within Sevier and Emery Counties, Utah, approximately 6 miles northwest of the town of Emery. Figure 1-3 shows the relationship of the three project components and local topography. Legal descriptions of each of the project components are given in Appendix A.

1.3 LEASING PROCESS/AUTHORIZING ACTIONS

This EIS evaluates three different actions, each of which represents a different phase in the Federal coal leasing process and coal mine permitting process. Each action is governed by overlapping rules and regulations. The appropriate regulations for each are discussed below.



U T A H

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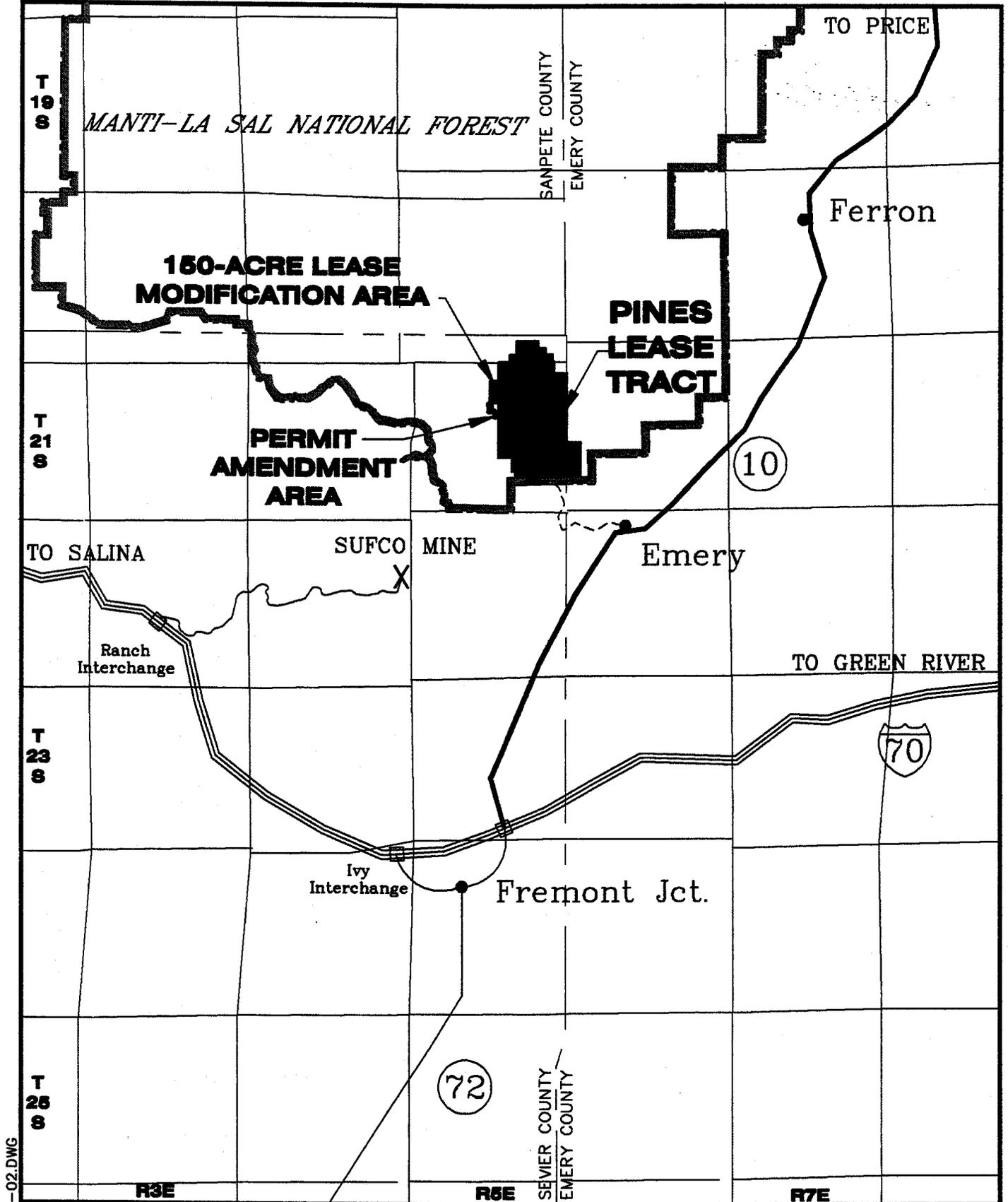
PINES TRACT PROJECT

**MANTI-LA SAL NATIONAL FOREST
PINES TRACT PROJECT**

FIGURE 1-1
REGIONAL LOCATION

SCALE 1"=40 MILES	DATE DRAWN 6/11/98	LAST REVISION 8/20/98
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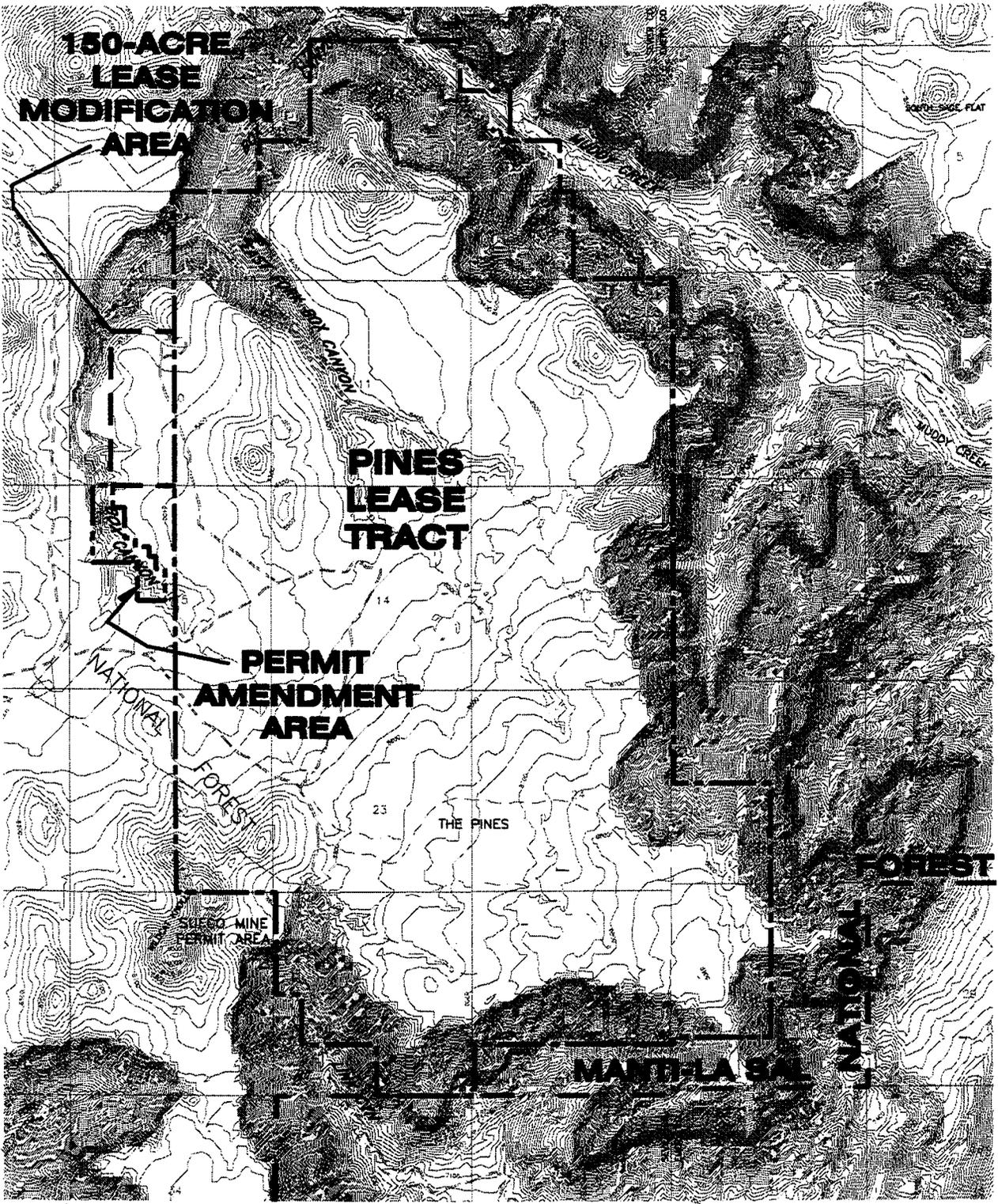
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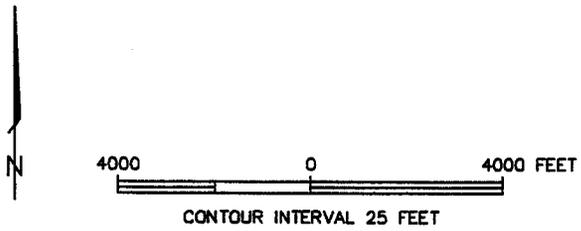
MANTI-LA SAL NATIONAL FOREST PINES TRACT PROJECT			
FIGURE 1-2 PROJECT LOCATION			
SCALE 1" ~ 5 MILES	DATE DRAWN 6/11/98	LAST REVISION 7/28/98	





**MANTI-LA SAL NATIONAL FOREST
PINES TRACT PROJECT**

FIGURE 1-3
PROJECT COMPONENTS



SCALE 1"=4000'	DATE DRAWN 7/28/98	LAST REVISION
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In order for a mining company to access Federal coal reserves, it must apply to lease the Federal lands for development of the coal resource. An application is submitted to the BLM, who administers the Federal mineral estate. BLM assesses the priority of applications and initiates the lease consideration process, which includes ensuring that a NEPA analysis is completed. Where necessary, the BLM cooperates with the Surface Management Agency (SMA), who, by agreement, may take the lead on the NEPA analysis.

The Federal coal lease application (Pines Coal Lease Tract) will be processed under the authority of the Mineral Leasing Act of 1920 (MLA), as amended by the Federal Coal Leasing Regulations Act of 1975, and procedures set forth under Federal Regulations at 43 CFR 3425, Leasing -on-Application (LBA). The BLM has leasing authority, but since the Pines Coal Lease Tract lies on National Forest System Lands, the FS is the SMA. Therefore, FS consent is required in order to lease. The FS must also prescribe conditions for the protection of non-coal resources, and direct the completion of the NEPA analysis. The FS and the BLM will develop terms, conditions, and stipulations during the NEPA analysis that will be applied to the coal lease (if it is offered for sale), to ensure MER of the coal resource and protection of the environment. The determination by the BLM that MER can be achieved in leasing the Pines Coal Lease Tract and associated stipulations can be found as a technical staff report in the FS MLS project files. The authorizing actions and decisions for leasing the Pines Coal Lease Tract are further discussed in Section 1.4 and outlined in Table 1.1 below.

If the tract is leased, it will be done under a competitive bid process at a lease sale. Granting the lease would give the successful bidder (the lessee) exclusive rights to mine the coal, but does not authorize mining or surface disturbing activities. This EIS considers the potential environmental impacts associated with leasing these lands for coal development. Reasonably Foreseeable Development Scenarios (RFDS), or conceptual mine plans, were developed by the BLM to serve as the basis for addressing potential impacts of coal development. The RFDS is further described under Section 1.5.

Once a lease is awarded, and before any lease development can occur (i.e. mining, surface facility development), the lessee or operator must obtain approval of a comprehensive PAP (which includes the Mining and Reclamation Plan [MRP]) and a mine permit. The PAP must comply with State and Federal regulations. Surface Management Agency (in this case the FS) consent/concurrence and provisions for protection of non-mineral resources are required prior to issuance of a mine permit. Approval of a Resource Recovery and Protection Plan under 43 CFR 3482 by the BLM is also required. The PAP must address and detail how the operator will comply with the terms, conditions and stipulations applied to the coal lease by the BLM and the SMA. Submittal of a PAP by the lessee/operator is a separate action following leasing.

The Surface Mining Control and Reclamation Act of 1977 (SMCRA) gives the OSM primary responsibility to administer programs that regulate surface coal mining activities and the surface effects of underground coal mining operations. In response to Section 503 of SMCRA, the Utah

Division of Oil, Gas and Mining (UDOGM) developed a permanent program authorizing UDOGM to regulate surface coal mining and the surface effects of underground coal mining on non-Federal lands within the State of Utah. UDOGM's program was approved by the Secretary of the Interior in January 1981. In March 1987, under Section 523(c) of SMCRA, UDOGM entered into a cooperative agreement with the Secretary of the Interior that authorized UDOGM to regulate surface coal mining and the surface effects of underground coal mining on Federal lands in Utah. The set of governing regulations are the Utah Coal Rules.

Under the cooperative agreement, Federal coal lease holders in Utah must submit a PAP to OSM and UDOGM for proposed mining and reclamation operations on Federal land in the State. UDOGM reviews the PAP to ensure that permit requirements are met and that the permit meets the performance standards of the approved permanent program. If compliance is met, UDOGM approves a mine permit to conduct coal mining operations. OSM, BLM, the FS and other Federal and State agencies also review the PAP to ensure compliance with terms of the coal lease, the MLA, NEPA and other applicable Federal and State laws. OSM is ultimately responsible for recommending for approval; approval with conditions, or disapproval of the MLA mining plan to the Assistant Secretary of the Interior, Lands and Mineral Management. The PAP must include a Probable Hydrologic Consequences (PHC) determination, which in turn is used by UDOGM to prepare a Cumulative Hydrologic Impact Assessment (CHIA).

UDOGM is responsible for enforcing the performance standards and permit requirements during mine operation, and has primary authority in environmental emergencies. OSM retains oversight responsibilities for this enforcement. The BLM performs periodic underground inspections of coal operations and enforces coal resource recovery, and the FS performs inspections on special use permits and cooperates with other agencies regarding inspections of other surface disturbing activities. BLM and the FS also have authority in those emergency situations where UDOGM or OSM inspectors can not act before environmental harm or damage occurs.

BLM is responsible for approval of coal exploration plans (i.e. drilling) within Federal leases under the MLA. UDOGM conducts reviews for compliance under the Utah Coal Rules for those exploration proposals that lie within permit areas already approved for mining. Under agreement between BLM and UDOGM, BLM has primary responsibility for exploration plan approval, compliance and inspection. UDOGM and FS cooperate with the BLM regarding inspections. All lease development activities subsequent to leasing are subject to site-specific analysis and authorizations under NEPA and other authorities.

The lease modification will be evaluated in accordance with 43 CFR 3432. The permit amendment will be evaluated according to 30 CFR 740-746.

1.3.1 Lease Pines Coal Lease Tract (UTU-76195)

Canyon Fuel (then Coastal States Energy Company) submitted coal lease application UTU-76195 to the BLM, Utah State Office on December 16, 1996. The application proposed a 5,786.9-acre

lease tract. The BLM then initiated assessment of the proposed lease. The first step in the lease evaluation process was to delineate the tract. Tract delineation was completed by the BLM in October 1997, which expanded the tract boundaries to encompass 7,311 acres. The tract delineation report is available in the FS MLS project file. After tract delineation, the LBA process calls for a Data Adequacy Review, application of Unsuitability Criteria, and conducting an environmental analysis of the proposed action. The Pines Coal Lease Tract contains an estimated 71 million tons (MT) of recoverable coal.

Data Adequacy Standards, as established by the Uinta-Southwestern Utah Coal Region, were met after the company submitted supplemental information requested by the reviewing specialists. Application of the Unsuitability Criteria for Coal Mining found in 43 CFR 3461 determined that the proposed tract is suitable for leasing. A detailed discussion regarding the application of unsuitability criteria and required consultations with the United States Fish and Wildlife Service (USFWS) and the Utah State Historic Preservation Office (USHPO) are contained in the project file. This NEPA document addresses the need for the environmental analysis for the coal lease according to 43 CFR 3425. Table 1.1 below shows the authorizing actions and decisions associated with leasing the Pines Coal Lease Tract.

1.3.2. Modify Federal Coal Lease U-63214 (Quitcupah Lease)

Canyon Fuel submitted an application with BLM to modify their existing Quitcupah Lease on January 12, 1998. A lease modification entails adding additional lands to an existing lease and is governed by the MLA. This analysis considers adding previously unleased land to Canyon Fuel's existing Quitcupah Lease, and adding 3.4 MT of coal reserves to the SUFCO Mine reserve base. The BLM must consider modifying the lease to encompass the additional reserves. The FS, as the SMA, must decide whether or not to consent to the BLM modifying the lease and ascertain the potential environmental impacts. The UDOGM has the permitting authority under the Utah Coal Rules, and would process mining proposals associated with the lease modification as an incidental boundary change (IBC) to the mine permit boundary. Table 1.1 shows the authorizing actions and decisions associated with modifying the Quitcupah Lease.

1.3.3 PAP Amendment to Subside Box Canyon

Canyon Fuel submitted a PAP amendment to UDOGM on January 19, 1998 (revised May 13, 1998) requesting approval to subside perennial reaches of Box Canyon using full extraction longwall methods. A permit amendment involves altering the approved PAP and mine operations plan to account for a change in the planned mining scenario. This EIS considers the application by Canyon Fuel to amend their approved permit and subside perennial portions of Box Canyon, currently not allowed under a lease stipulation. The Permit Amendment Area is encompassed in Canyon Fuel's current Quitcupah Lease holding, and contains an estimated 2.2 MT of recoverable coal. In this case, the FS and the BLM must assess whether or not to specifically approve mining that would cause subsidence of the escarpments and perennial drainage. Authority is given under the MLA, as amended. This action is subject to a site-specific environmental analysis under NEPA because it could involve surface disturbance not previously

analyzed. Table 1.2 shows the authorizing actions and decisions associated with approving the permit amendment.

Table 1.1 Decisions and Authorizations Required for the Proposed Action (Lease Pines Tract and Modify Quitchupah Lease, U-63214)

Agency/ Responsible Official	Decisions	Authority
BLM/ Utah State Director	Offer Pines Coal Lease Tract for Competitive Bidding and include Lease Stipulations Modify U-63214 and include Stipulations	MLA, NEPA
FS/ Forest Supervisor, MLS	Consent to leasing by BLM and prescribe stipulations for protection of non-coal resources	MLA, as amended by Federal Coal Leasing Amendment of 1975, NEPA

Table 1.2 Decisions and Authorizations for the Proposed Action (SUFCO Permit Amendment to Subside Box Canyon)

Agency/ Responsible Official	Decisions	Authority
UDOGM/ Director	Approve the Permit Amendment	MLA, Utah Coal Rules, 30 CFR 700 et seq.
BLM/ Utah State Director	Approve Change to the SUFCO Mine Resource Recovery Plan (Mine Plan)	MLA, NEPA, 43 CFR 3400 et seq.
FS/ Forest Supervisor, MLS	Consent to approval of the Permit Amendment by UDOGM	MLA, NEPA, 43 CFR 3400 et seq.

1.4 DECISIONS TO BE MADE BY RESPONSIBLE OFFICIALS

This EIS addresses the need for three Federal decisions, one associated with each of the three project components. The Forest Supervisor for the MLS, and the Utah State Director for the BLM are the responsible officials for the EIS. They will make their respective decisions regarding the proposed actions after considering the comments, responses, and environmental

consequences discussed in the EIS. The rationale for each agency decision will be documented in a ROD.

The first decision is a joint FS and BLM decision regarding the Pines Coal Lease Tract. The Forest Supervisor must decide whether or not to consent to the BLM offering for lease the lands in the Pines Coal Lease Tract. The BLM, Utah State Director must decide whether or not to offer the lease tract as delineated by the tract delineation team for competitive sale and subsequent coal resource development. The authorities for these decisions are discussed in Section 1.3, and shown on Table 1.1 above.

The second decision is also a joint FS - BLM decision. The Forest Supervisor must decide whether or not to consent to the BLM modifying Canyon Fuel's existing Quitchupah Lease, and add 150 acres of previously unleased land. The BLM, Utah State Director must decide whether or not to modify the lease and add the additional coal reserves. Authorities for this decision are discussed above, and shown on Table 1.1 above.

The third decision, considered by the Forest Supervisor and BLM, Utah State Director is whether or not to except lease stipulation 13 on the existing Quitchupah Lease (stipulation 9 from the Forest Plan, Appendix B, page B-3), specifically approving mining that would subside perennial reaches of Box Canyon and associated escarpments. If approved, the FS would consent/concur with approval of the corresponding permit amendment by UDOGM.

1.5 HISTORICAL MINING AND REASONABLY FORESEEABLE DEVELOPMENT

Mining activity has been occurring in the vicinity of the Project Area since the 1940s and 1950s. Small scale operations were historically located in Link Canyon and Quitchupah Canyon. Continuous operations at the SUFCO Mine have been occurring since 1941, under various names and operators. Modern longwall mining techniques have been used in the SUFCO Mine since 1985. Canyon Fuel currently holds active Federal coal leases U-63214 (Quitchupah Lease), U-47080, U-28297 and U-0149084. Current annual production is estimated at 5.88 MT.

The Pines Coal Lease Tract is located immediately adjacent to the approved permit area for Canyon Fuel's SUFCO Mine, and includes the Quitchupah Lease. The Lease Modification Area is situated on the northeast boundary of the Quitchupah Lease, and the Permit Amendment Area in Box Canyon is located directly south of the Lease Modification Area (see Figure 1-3).

In order to evaluate the proposed actions and consider the potential effects of implementation, RFDS or conceptual mine plans were developed to serve as the bases for the effects analysis.

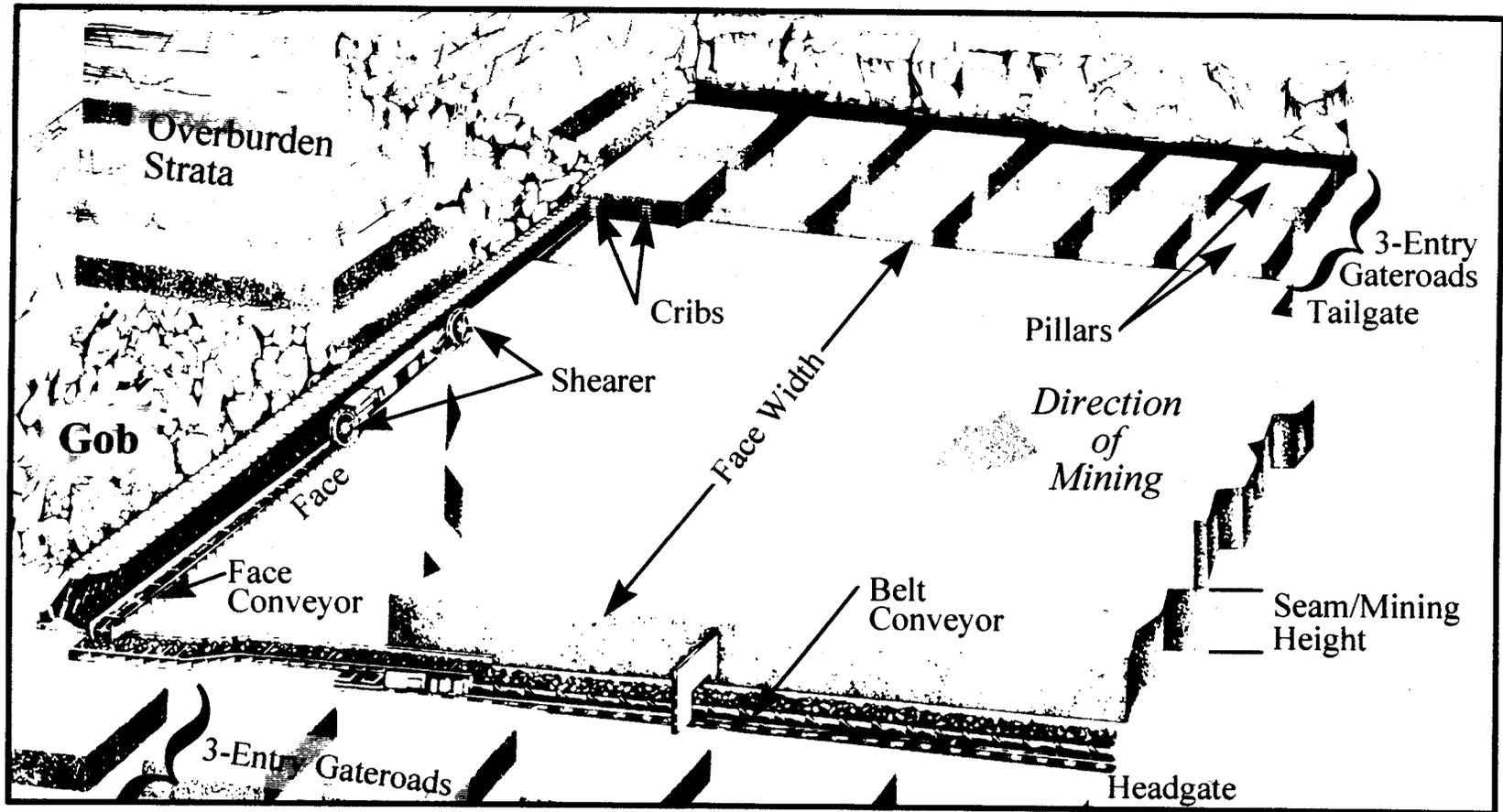
If the Pines Coal Lease Tract is offered for lease, it will be by competitive sale, thus it is possible that a company other than Canyon Fuel could obtain the right to lease and develop the Pines Coal

Lease Tract. Therefore, this analysis must consider a mine development scenario typical of what might occur, regardless of what operator obtains the lease. The BLM created an RFDS for the project that is contained in the FS MLS project file. Whether by Canyon Fuel or another mining company, the Pines Coal Lease Tract would be mined exclusively using underground mining techniques. Longwall mining would be used for coal recovery, and continuous miner techniques would be employed to drive development workings. Figure 1-4 shows a schematic of a typical longwall panel with gateroads and development workings. BLM foresees that the Pines Coal Lease Tract could be mined by orienting longwall panels north-south through the bulk of the lease tract. Approximately 10 panels, each about 1,000 feet wide and up to 19,000 feet long, could be mined in this way. Three additional panels could be developed in the southernmost section of the tract, and would be oriented east-west. These would likely be about 1,000 feet wide and up to 9,000 feet long. The RFDS assumes full extraction mining would be possible in most of the lease tract, with some exclusions near the northeast and south outcrops where there are indications of coal burn. The RFDS also assumes that the gateroad entries will be a 3-entry, rigid pillar system. Surface subsidence and ground movements associated with potential longwall mining are discussed in Section 3.1.1. Expected production from the Pines Coal Lease Tract is estimated at 6 to 9 MT per year, representing 15 years to 20 years of additional mine life.

Mining of the Pines Coal Lease Tract would entail constructing a ventilation, escapeway and mine drainage breakout on the north end of the tract. The breakout would potentially be at the coal outcrop in Box Canyon about 1,000 feet up-canyon from the intersection with Muddy Canyon. The breakout would likely be 800 square feet and would be constructed from inside the mine. The only surface disturbance would be a foot path for use as an escapeway.

Exploratory drilling to further delineate coal reserves would also be needed. It is estimated that 6 to 10 coal exploration holes would be needed, representing up to 40 acres of surface disturbance depending on the amount of new access roads required. The roads and pads would be reclaimed as soon as possible after completion and would present only short-term disturbance. Past reclamation and revegetation in the Quitchupah/Pines area has been very successful, and is generally achieved within 3 years to 5 years.

There is also a potential need to temporarily discharge mine water for 2 years to 3 years into Link Canyon until a breakout in lower Box Canyon/Muddy Canyon could be completed to receive potential future mine water discharge. A discharge point into Box Canyon/Muddy Creek would require special approval from the State of Utah under antidegradation rules. The temporary discharge in Link Canyon would be approximately 1,000 gallons per minute (gpm). The discharge would be conveyed down-canyon through a discharge pipe to a point in Link Canyon Wash beyond the MLS boundary.



**MANTI-LA SAL NATIONAL FOREST
PINES TRACT PROJECT**

FIGURE 1-4
TYPICAL LONGWALL SCHEMATIC

SCALE NONE

DATE DRAWN 7/28/98

LAST REVISION

If Canyon Fuel obtains the Pines Coal Lease Tract, it would access it through an extension of underground workings in the active Quitchupah Lease. It would maintain their existing portal facilities in Convulsion Canyon on the Fishlake National Forest, and no new facilities would be needed. It is assumed that coal would be hauled along the existing haul routes, but would increase proportionately with production. Mine water discharge into Link Canyon would entail placing approximately 1,500 feet of pipe in a trench and bench along the west side of Link Canyon from a breakout in Link Canyon from the existing SUFCO Mine. The pipe would be contoured along slope to a point below the Forest Boundary, where the discharge would enter Link Canyon wash.

If another company obtains the Pines Coal Lease Tract, surface facilities for a new mine would be needed. These facilities would likely be located at the coal outcrop in Link Canyon. Total surface disturbance for the new facilities, including upgrading and straightening the existing Link Canyon road from SR-10 to the mine site, is estimated at 100 acres. Mine water discharge would be conveyed through a 2,500-foot pipeline likely in or adjacent to the road leading to the portal facilities. Water would be piped to a point below the Forest boundary and discharged to Link Canyon Wash.

Potential mining in the Lease Modification Area would occur as an extension of underground longwall panels from the SUFCO Mine operations. Because the Quitchupah Lease is already held by Canyon Fuel, no other company could obtain this area. Likewise, potential undermining and subsidence of Box Canyon (Permit Amendment Area) would occur as an extension of underground longwall panels. Because the Permit Amendment Area is within the boundaries of the existing lease and the approved SUFCO Mine Permit Area, no other company could obtain rights to it.

If the PAP amendment is not approved, and mining that would cause subsidence is not allowed under Box Canyon, the potential for full support first mining would still exist. This would assume that full-support entries would be driven (there would be no subsidence) under Box Canyon to access reserves in the Lease Modification Area.

A possibility exists that if subsidizing Box Canyon is not approved, Canyon Fuel might withdraw their application for the Lease Modification Area. In terms of this analysis, it will be assumed that the Lease Modification Area would be added to the Pines Coal Lease Tract in the leasing decision if it is not added to the Quitchupah Lease. If this is the case, then room-and-pillar mining would be likely in the Lease Modification Area, as longwall panel development would not be warranted based upon size and orientation.

2.0 ISSUES AND ALTERNATIVES INCLUDING THE PROPOSED ACTION

During the initial stages of the Pines Tract Project, comments were solicited from appropriate agencies, specific individuals, and the general public. The comments received were analyzed and summarized to represent the issues and concerns of the respondents. Based on and in response to the issues, the FS developed a range of alternatives that meet the purpose of and need for the project (as identified in Section 1.1 Purpose and Need).

The alternatives propose a range of specific actions that could be implemented and include: 1) Lease the Pines Coal Lease Tract as previously delineated by the BLM Interagency Tract Delineation Team through the competitive bid process; 2) modify the Quitchupah Lease (U-63214) by adding 150 acres (Lease Modification Area); and 3) evaluate a permit amendment submitted by Canyon Fuel that proposes to mine under and subside the perennial stream and escarpments in Box Canyon (currently not allowed under lease stipulations of the approved SUFCO Mine permit) (Permit Amendment Area).

2.1 PUBLIC INVOLVEMENT PROCESS

Public involvement is an important part of the environmental analysis process. The public involvement plan describes the methods and techniques that will be used to involve the public in the environmental analysis. It allows the public to participate actively in the NEPA process and to communicate their concerns regarding the proposed action. In addition, involvement of local, State, and other Federal agencies helps them to anticipate the effects and benefits that could occur from the project and to make necessary plans and changes in public policy.

The FS initiated public scoping for the Pines Tract Project on October 16, 1997 with the intent of preparing an EA. Due to the increasing public interest in coal leasing on the Wasatch Plateau and the complexity of issues identified during the original scoping effort, the FS determined that the proposed project warrants preparation of an EIS. A Notice of Intent (NOI) to prepare an EIS, initiating the formal 30-day scoping period, was published in the Federal Register on January 29, 1998 (Volume 63, Number 19; Page 4427-4428). A revised NOI, describing the proposed actions in more detail, appeared in the Federal Register on April 14, 1998 (Volume 63, Number 71; Page 18181-18182).

A public scoping letter was sent to 132 parties on the project mailing list on February 3, 1998. A legal notice of the proposed Pines Tract Project was also sent to The Sun Advocate, the newspaper of record for Forest Supervisor decisions on the MLS, and was published on February

5, 1998. The legal notice was also published in supplemental papers, including the Emery County Progress (February 10, 1998) and the Richfield Reeper (February 11, 1998). The purpose of the public scoping letter and news release was to inform the public that the FS and BLM intended to complete the environmental analysis as an EIS. Information was provided about the proposed lease, and public comments were solicited to identify specific issues that should be addressed during the analysis and documented in the EIS.

The FS received a total of five written comments and two verbal comments (one telephone call, one personal visit) during the EA public scoping period and nine written comments during the first EIS public scoping period (initiated on January 29, 1998) from parties responding to the NOI, news release, and public scoping letter. In response to the amended NOI, the FS received two additional written comments.

2.2 ISSUES CARRIED FORWARD IN ANALYSIS

Common issues relating to the proposed project were identified and based on the comments received during the public scoping process. These issues, along with issues identified by the FS Interdisciplinary Team, were carried forward in this EIS analysis. These issues are identified by individual resource and are listed below.

TOPOGRAPHY, GEOLOGY, AND SUBSIDENCE

Mining activities associated with the proposed analysis area could result in subsidence-induced ground movements, changes in geology and topography.

1. Areas of geological interest, such as natural bridges, arches, escarpments, and alcoves could be disturbed from subsidence.

HYDROLOGY - GROUNDWATER

Mining activities associated with the proposed analysis area and associated subsidence-induced ground movements could interrupt or degrade groundwater within or adjacent to the lease tract. Groundwater quality and quantity, and how these variables affect vegetation, wildlife, livestock, water rights, and future water sources, were underlying themes of many of the comments received.

1. Groundwater within the Project Area supports flows to springs, riparian areas, and wetlands. Groundwater may be interrupted due to subsidence-induced ground movements and fracturing of the strata. This interruption of groundwater could result in a reduction in surface acreage of riparian areas and/or wetlands within the Project Area. This interruption could also result in impacts to livestock and wildlife that are seasonally supported by the springs in the area.

2. Groundwater and surface water rights could be negatively impacted as a result of proposed mining activities.
3. Mine equipment could be left underground after mining activities have been completed, which could have the potential to degrade groundwater quality.
4. Subsidence could alter shallow aquifers which could be used as groundwater sources.

HYDROLOGY - SURFACE WATER

Mining activities associated with the analysis area and associated subsidence-induced ground movements could result in impacts (either reduction in flows or elimination of water source) to surface drainages, riparian areas, wetlands, and springs. Changes in flow could alter the riparian vegetation, available water to livestock and wildlife, and wildlife habitat. Discharges from the mine could degrade water quality and flows of Muddy Creek of Link Canyon Creek or of Quitchupah Creek, if discharge continues. If a new mine is developed in Link Canyon, sediment/other contaminants could be introduced to Link Canyon.

1. The project area contains several perennial streams, springs, riparian areas, and wetlands. These springs, riparian areas, and wetland areas are supported by groundwater sources. Subsidence or other mining operations could divert water supplying these areas. These springs, riparian areas, and wetlands support livestock, wildlife, and various vegetation.
2. The Muddy Creek provides drinking water and secondary irrigation water to the Town of Emery. There is a concern that mining within the Project area would have an impact upon water quantity and water quality of Muddy Creek. The environmental analysis should review cumulative and incremental mining impacts to water resources.
3. Should another company obtain the lease and develop a mining operation at Link Canyon (or another location), then increased surface disturbance has the potential to increase erosion, and hence sediments in surface drainages, and other surface related pollutants.
4. The proposed project is within the Colorado River Basin. As such, there is the potential that the proposed project could result in impacts to special status species found in the Colorado River and its tributaries. Changes in flow (increase or decrease) and water quality could modify the habitat for these species.
5. Escarpment failures and subsidence could alter the course and/or grade of surface drainages within the Project Area.

6. Increases or decreases in surface water flows may result in impacts to water rights and water availability for livestock and wildlife uses (stock watering ponds).
7. Underground mining may cause transbasinal diversions of intercepted (and then discharged) ground water within watersheds and subwatersheds. Ground water intercepted is either used in the mine underground, or discharged from the workings. There was concern that water intercepted underground may be discharged into a watershed other than the watershed for which it was originally destined.

VEGETATION

Mining activities associated with the analysis area and associated subsidence-induced ground movements could result in impacts to riparian areas, wetlands, springs, and the unique vegetation of the escarpments. Areas exhibiting subsidence could also result in impacts to timber resources. Surface disturbance could also create direct impacts to vegetation. Construction of a new mine in Link Canyon could remove approximately 100 acres of vegetation.

1. Subsidence-induced ground movement could alter groundwater flows to riparian areas, wetlands, and springs. The vegetation associated with these areas could be altered by reduced flows.
2. Escarpment failure could result in the loss of the unique vegetation found where groundwater seeps out of the escarpments.
3. Timber resources could be impacted through construction of new surface facilities.
4. New surface disturbance associated with proposed mining has the potential to encourage the invasion of noxious weeds and/or exotic plants.
5. Mining-induced subsidence and surface disturbance associated with mining has the potential to impact threatened and endangered species or their habitat within the analysis area.
6. Construction of a new mine in Link Canyon could remove approximately 100 acres of vegetation.

WILDLIFE

Mining activities associated with the analysis area and associated subsidence-induced ground movements could indirectly result in impacts to wildlife. These include loss of riparian habitats, loss of available water, loss of upland/escarpment habitats, changes in wildlife diversity, and alteration of movement patterns. Direct losses due to wildlife-vehicle interactions are also likely to increase. If new surface facilities are developed, habitat losses would occur.

1. Mining activities and associated subsidence-induced ground movements could result in impacts to perennial streams, riparian areas, wetlands, and springs (either reduction in flows or elimination of water source). Potential impacts could occur to vegetation and forage production, sage grouse lek areas, big game winter and transitional ranges, and wildlife migrational routes.
2. Coal haulage has the potential to increase deer/elk vehicle-related mortality due to increased coal production and the increased time period over which mining would occur.
3. Subsidence-induced ground movements associated with underground mining activities could alter habitat for wildlife. Specifically raptor nesting (e.g., peregrine falcon and goshawk) and bat roosting habitat could be lost due to escarpment failures.
4. Mining activities could result in impacts to the Western blue bird through loss of nesting habitat. Subsidence-induced ground movements could disrupt forest habitat, or disruption of flow to riparian habitats could result in a loss of aspen. The Western blue bird may be highly localized to the area and negative impacts could have the potential to significantly impact the whole population.
5. Mining-induced subsidence and surface disturbance associated with mining has the potential to impact threatened and endangered species or their habitat within the Pines Tract Project Area.
6. Habitat losses associated with potential new surface facilities (measured in acres).

CULTURAL RESOURCES

Cultural and paleontological resources could be impacted by mining related activities and subsidence-induced ground movements, and by the construction of a new mine in Link Canyon.

1. Construction of surface facilities and subsidence-induced events, such as seismic events, cracks, changes to topography, and escarpment failures, or groundwater discharge could affect significant archaeological, paleontological, and historical resources.

LAND USE

Approval of the proposed lease actions may result in impacts to land uses within the area (e.g., existing and future surface development and/or other lessees).

1. Subsidence-induced ground movements and new facilities could damage surface structures such as roads, pipelines, power lines, stockponds, developed springs, other facilities, and survey monuments.
2. Approval of the Pines Tract Project and associated mining needs to be compatible with multiple-use of public lands and should be consistent with Federal, State, and local land use policies.
3. Coal leasing could conflict with oil and gas/leasing, exploration, and production.

RECREATION

Approval of the proposed lease actions and proposed subsidence of Box Canyon could result in degradation of the recreation experience.

1. Mining related activities and associated subsidence-induced ground movements could result in impacts to the recreational experiences in the Pines Tract Project Area.
2. Effects of the proposed action in roadless areas.
3. Construction of a new mine in Link Canyon and reconstruction of the Link Canyon road could affect recreation access to the Pines Tract Project Area.

PUBLIC SAFETY

Approval of the proposed lease actions and operations could create potential hazards to public safety.

1. Mining-induced subsidence could result in escarpment failures (i.e. falling rocks), which could affect public safety.
2. Existing roads could be impacted as a result of escarpment failures and subsidence-induced ground movements.
3. Increased production and extension of haul traffic into weekends could increase the potential for traffic accidents. The increased duration of haul traffic could also extend this impact to the end of mine life.
4. The operation of a new mine in Link Canyon could result in increased coal hauling on SR-10 and through local communities and an increased amount of accidents.

RANGE/LIVESTOCK

Livestock distribution is a function of available forage and water distribution. Livestock trailing is also conducted within the proposed Pines Tract Project Area.

1. Subsidence-induced ground movements and surface cracks could alter water supplies and distribution of water on the Project Area.
2. Subsidence-induced ground movements and surface cracks could damage surface structures such as fences, troughs, pipelines, other range improvements, and interfere with trailing routes.
3. Construction of new facilities, especially haul roads, could impact trailing of livestock during specific periods of the year in Link Canyon.

VISUAL RESOURCES

Mining activities, including surface facilities, and escarpment failures could impact visual quality of the area.

1. Mining-induced subsidence could result in escarpment failures, which may lead to alterations in the natural topography and visual quality.
2. Construction of surface facilities could alter the visual aspect of the area.

NOISE

Mining activities include the use of heavy equipment, conveyors, and haul trucks which all generate noise.

1. Approval of the proposed lease actions could result in continued and increased amounts of human-generated noise from the breakout in Muddy Creek and/or in Link Canyon if a new mine is developed.

TRANSPORTATION

Increased coal production could result in increased haulage needs. The extension of mining activities could result in haulage traffic for a longer period of time. A new mine in Link Canyon would result in coal hauling down Link Canyon road to SR-10.

1. Increased haulage could increase road damage and maintenance costs
2. Increased haulage could conflict with design traffic levels on haul routes, resulting in additional accidents.
3. Subsidence effects on roads.

4. Impacts of hauling coal to power plants.
5. Collisions with wildlife.
6. A new mine in Link Canyon would require reconstruction of the Link Canyon road and potentially interfere with existing access to the Pines Tract Project Area.

SOCIOECONOMICS

Approval of the proposed lease actions and mining operations has social and economic impacts on the local and regional communities. The different alternatives to be developed for the lease action will have different potential coal recovery amounts.

1. Continued coal mining provides economic benefits such as employment, royalties, income, and tax revenues on a local and regional level.
2. The approval of the proposed lease actions and mining operations could result in a loss of value for the public's ownership in regard to future types of development opportunities.
3. Recoverability of Federal coal reserves.

2.3 ISSUES NOT ANALYZED IN DETAIL

The following issues identified through the public scoping process were determined to be outside the scope of the proposed action, already decided (by law or Forest Plan, etc.), irrelevant to the decision, or not affected by the proposed action. Therefore, these issues were not analyzed in this EIS. Issues not analyzed in detail in this EIS are summarized below. The rationale or justification for not analyzing these issues in detail is presented immediately following the summation of each individual issue.

Issue 1: *Mining related activities, such as drilling, and/or mining-induced subsidence could damage or alter the position of survey monuments and rectangular survey monuments (section corners and ¼ corners).*

Federal and State laws require the repair or replacement of damage survey monuments. The Forest Surveyor has provided a list of known section corners. If the Special Coal Lease Stipulations (SCLSs) are included in the selected alternative, SCLS #16 requires replacement of these monuments.

Issue 2: *An alternative which proposes a land exchange should be considered.*

Leasing Federal lands for development of energy resources is encouraged under the Mineral Leasing Act of 1920, if consistent with other laws and Forest Plan standards and guidelines. Subsidence of the land surface does not eliminate the value of land for other resources or public ownership. The Forest Plan determined that this area is available for further consideration for coal leasing; therefore considering a land exchange is unnecessary and outside the scope of this analysis.

Issue 3: *Consider alternative sources of energy (wind power or solar).*

The Mineral Leasing Act of 1920 encourages development of mineral resources on Federal lands. This analysis considers an application to lease Federal lands for coal development. Addressing alternative sources of energy does not meet the purpose and need of the project.

Issue 4: *Financial recovery to fair market value under FLPMA.*

Financial recovery is mandated under FLPMA by conducting lease sales under a competitive bid process. The competitive lease sale may occur if the agencies' decisions are to lease the tract. It is Department of Interior's policy to use a combination of like coal lease sales in a region and/or a discounted cash flow analysis to determine fair market value for coal. Although coal leasing is a discretionary action under the authority of the Secretary of the Interior, it is currently policy to use these methods to determine fair market value. It is beyond the needs of this analysis to address changes to this policy.

Issue 5: *Address mine reclamation and clean post-mine water assurance to meet BLM undue and unnecessary degradation clause.*

The leasing process allows for the surface management agency to require lease stipulations for protection of non-mineral resources. This would meet the intent of the BLM's undue and unnecessary degradation clause. Additionally, mine reclamation will be addressed in the MRP required to obtain a mine permit from the UDOGM. The MRP must meet rigorous environmental protection regulations under SMCRA, Forest Plan standards and guidelines, Utah State Coal Rules, and meet the Utah Division of Water Quality rules on anti-degradation. Compliance with these regulations is inherent in the permitting process, and further analysis is not warranted.

Issue 6: *If mine refuse/spoil is placed on the surface, what is the potential to contribute to acid mine drainage or heavy metal contaminants.*

Surface Mining Control and Reclamation Act (SMCRA) regulations and the Utah Coal Rules require testing of all spoil and stockpile materials, and have provisions for neutralization and/or disposal in a manner safe for the environment. These will be considered under the mine permitting process. The potential for materials left underground to affect groundwater quality is evaluated in the EIS.

Issue 7: *If the coal is processed at a washer or screening yard, how will the losses be accounted for?*

Under the current mining situation, and in the foreseeable development of this tract, washing facilities are not being and will not be used. Screening is done for crushing and sizing. All the coal is stockpiled for later sale. Losses are negligible.

Issue 8: *What is the possibility that a lessee will apply for royalty reduction if it is proven that the Federal royalty is an excessive economic burden?*

There is a provision that allows for royalty reduction if the applicant qualifies or if the coal value or quality becomes an issue. This is an issue that will be considered during lease administration and is not pertinent to the decision whether or not to lease lands for coal development.

Issue 9: *Are the lands public domain or acquired lands? [I]f the USA owns all the mineral rights, and the gas rights are presently leased, at what point in time will the lessee of both leases be required to enter into a cooperative agreement to ensure optimum recovery of both resources?*

These are public lands. The gas rights are not currently leased. The EIS for Oil and Gas Leasing for Lands Administered by the MLS indicates only moderate potential for oil and gas occurrence in this area. In past exploratory drilling, there were no discoveries of economic deposits. Oil and gas leasing may occur in this area in the future; and if a conflict is identified, BLM will resolve the multiple-resource development issue.

Issue 10: *The EIS should address the need for a long-term bond in addition to the lease bond.*

Bonding for the lease is required and is implemented during lease administration. Bonding is handled by the BLM and is intended to protect the government from

monetary losses by default. Under agreement between the Federal government and the State of Utah, the State is the lead agency for reclamation. Another bond will be required by UDOGM commensurate with the actual cost of reclamation as a provision of the mine permit approval. Bonding is covered under SMCRA permitting process and no further analysis is warranted.

Issue 11: *In the event the coal lease terminates, yet the lessee continues to use the underground passageways through mined areas of the tract, what form of compensation will be paid to the USA for "easement?"*

BLM coal lease regulations and lease terms provide for compensation to the government if a lease is terminated due to non-compliance. If a lease terminates, use of underground workings would not be allowed. Underground workings cannot be accessed unless a lease agreement is in place. This is a consideration that will be handled under the lease administration, and is not pertinent to the consent decision for leasing.

Issue 12: *How often will the BLM or FS visit the mine prior to, during and after mining operations to ensure compliance with the mining plan required?*

Since the BLM is the administrator of the mineral estate on Federal lands, they perform inspections for MER on a minimum quarterly basis. The terms of the MRP are administered by the UDOGM; they perform inspections on a monthly basis. The FS periodically inspects mine sites to ensure operations are consistent with the lease stipulations.

Issue 13: *If the coal under the subject tract is not leased, what is the likelihood that it could be mined in the future by itself? If the coal is not mined, how will BLM monitor adjacent mining to ensure there is not trespass?*

Lease Tract Delineation by the BLM is designed to specifically prevent bypassing coal reserves or creating a captive coal situation. The amount of reserves in this tract at current prices could sustain an independent operation, but may not be economic in the future. BLM monitors locations of underground workings to ensure that trespass does not occur as part of their inspection and enforcement. This is part of lease administration and not germane to leasing.

Issue 14: *How will subsidence effect timber resources (root system damage)?*

Previous studies conducted by the FS have not indicated that timber root systems would be significantly impacted by subsidence.

Issue 15: *Air pollution effects from coal burning?*

Coal mined from the Pines Tract Project Area would likely be transported to power plants and other coal burning facilities. The quality of the coal in the Pines Tract Project Area is comparable to that of coal located in the Wasatch Plateau, which typically is low in ash and sulfur (i.e., high compliance coal). These coals are desirable for power plants because they produce very few particulates. On average, Wasatch Plateau coals contain 0.68 % sulfur. The coal in the Pines Tract Project Area averages 0.50% sulfur. Air quality impacts resulting from the burning of coal by end users is outside the scope of this EIS. Since this is a competitive lease process, the site where the coal is to be burned is unknown. In addition, these impacts would occur (end users would continue to burn coal at these facilities) whether the Pines Tract Project was approved or denied. Compliance with air quality standards is under the jurisdiction of the Utah Department of Environmental Quality and the EPA at the locations where the coal is burned.

Issue 16: *One year of baseline data is not sufficient to analyze potential impacts.*

Several resources have more than 1 year of baseline data. Raptor studies, wildlife surveys, range/vegetation surveys, etc. have been ongoing for the purpose of monitoring other management activities, such as range management and other coal mining in the area. Impacts from other similar projects can be used where insufficient data exists, or can be predicted from models (subsidence and groundwater models). The environmental analysis can also identify potential impacts when either the data is not available for quantification or the impacts cannot be accurately determined.

Issue 17: *Suggest alternatives that would delete areas that have been delineated by the Tract Delineation Team.*

The Forest Plan determined that this area is available for further consideration for coal leasing. The EIS is being done to further consider it. The management prescriptions and multiple-use management decisions for the Project Area include minerals activities. Deleting areas from the lease tract have not been deemed necessary.

2.4 PROJECT ALTERNATIVES

The formulation of alternatives was guided by the focus issues; purpose and need; post-mining land use objectives of the Forest Plan; and the need to comply with Federal, State, and local laws, regulations, and policies. Alternatives were also developed to comply with the requirements of

NEPA to analyze a reasonable range of alternatives. The potential alternatives were evaluated by the Interdisciplinary Team (IDT) to determine whether they addressed the focus issues, met the purpose and need of the project, and were technically and economically feasible. The alternatives range from not allowing any of the proposed actions (No Action), to allowing all three actions in their entirety, plus two intermediate alternatives. The formulation of alternatives also included some that were only used for analysis as a means to compare impacts or the need to comply with Federal, State, or local laws, regulations, and policies.

During the alternative development process, the IDT reviewed a reasonable range of potential alternatives to the proposed actions. The alternatives developed encompass the complete spectrum of possible decisions that range from no leasing, mining through, mining all recoverable reserves with no special stipulations for the protection of non-mineral resources. This allows the responsible officials to select portions of the alternatives in their respective decisions as needed to protect specific areas and resources. The location of surface facilities, access, and water discharge points could change in response to various issues. A variety of factors were examined during the development of the alternatives for the DEIS. Consideration was given to avoidance and/or minimization of effects to water (surface and groundwater), special status species, wildlife, unique vegetation or vegetation which exist in limited quantities, public safety, and range/livestock. The steep natural terrain within and surrounding the mine area limits the options available for locating roads and other surface facilities.

Alternatives B, C, and D analyze the development of the Pines Coal Lease Tract under two development scenarios to account for the competitive bid process. Since the coal lease tract will be offered for competitive sale, there is no means for predicting who will be the successful bidder. Therefore, the analysis presents effects assuming the two development scenarios as described in Section 1.5. The proposals require three decisions for the FS and the BLM (as described in Section 1.4): 1) whether or not to lease the Pines Coal Lease Tract as delineated; 2) whether or not to add the 150-acre lease modification to the Quitchupah Lease (Lease Modification Area); and 3) whether or not to except Stipulation #13 on the Quitchupah Lease and allow underground mining operations that result in surface subsidence, which could cause the creation of hazardous conditions such as potential escarpment failures and landslides, ..., or damage or alter the flow of perennial streams in specifically approved locations (Permit Amendment Area). Therefore, the FS and BLM must consider leasing lands that have not previously been leased (the Pines Coal Lease Tract and the Lease Modification Area), and consider excepting the stipulation that precludes subsidence of perennial drainages and escarpments in Box Canyon (Permit Amendment Area).

Four alternatives were considered for analysis in this EIS, as follows:

No Action Alternative -- No Lease Alternative/No Subsidence of Box Canyon.

Alternative B -- Lease the proposed areas with Standard BLM Lease Terms and Conditions.

Alternative C -- Lease the proposed areas with Standard BLM Lease Terms and Conditions, and SCLSs for Protection of Non-Coal Resources (which would not allow subsidence of escarpments and perennial drainages in the analysis area).

Alternative D -- Lease the proposed areas with Standard BLM Lease Terms and Conditions, and SCLSs for Protection of Non-Coal Resources, allowing subsidence of perennial drainages and escarpments in the analysis area.

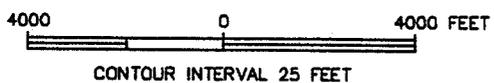
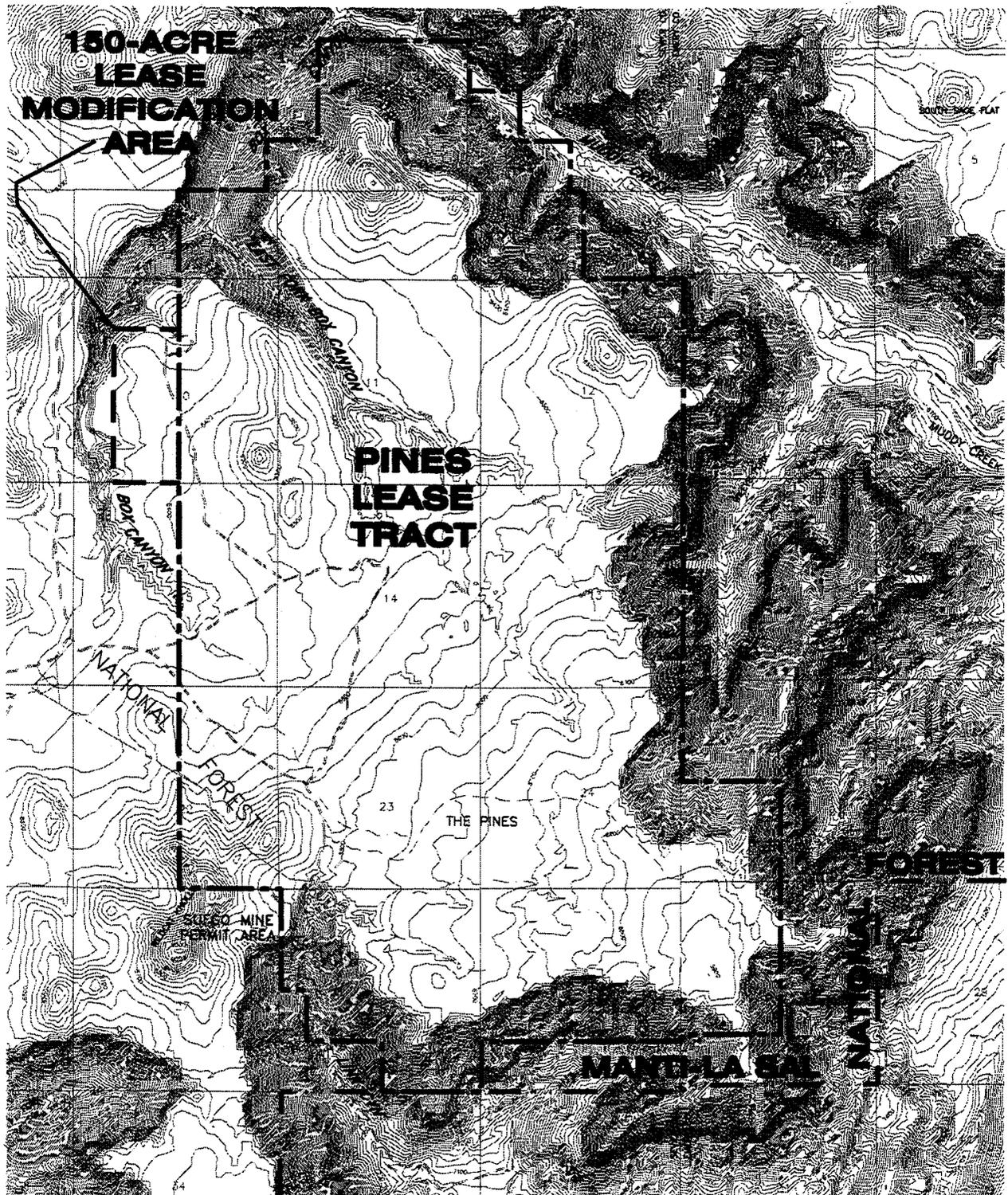
2.4.1 No Action Alternative -- No Lease Alternative/No Subsidence of Box Canyon

The No Action Alternative is required by CEQ 40 CFR Part 1502.14(d). Under the No Action-No Lease Alternative, no mining would take place within the Tract. The tract would not be offered at this time to the competitive bid process. The SUFCO Mine would continue to mine under its existing Quitchupah Lease. In addition, mining would be conducted in a manner to prevent subsidence under Box Canyon and no modification of the Quitchupah Lease would occur (i.e., no mining within the 150-acre proposed lease modification). Impacts from mining within these areas, including the Pines Coal Lease Tract, would not occur. No mitigation measures or monitoring would be required as part of this alternative other than meeting FS Plan direction, standards, and guidelines. Effects from on-going land uses in the Project Area would continue at present levels.

2.4.2 Alternative B -- Lease the proposed areas with Standard BLM Lease Terms and Conditions

This alternative is for analysis purposes only and is not a selectable alternative. This alternative does not include the portion of the analysis area that encompasses Box Canyon, since it is already addressed under the Quitchupah Lease. However, this alternative does include the Pines Coal Lease Tract and the 150-acre Lease Modification Area. Figure 2-1 shows the areas encompassed under this alternative. The Pines Coal Lease Tract would be offered for lease through the competitive bid process. Such a lease would include the standard BLM terms and conditions that are included on the BLM Coal Lease Form 3400-12 (April 1996) (Section 1 through 14). This alternative would not include SCLSs for the protection of non-coal resources (Section 15 Special Stipulations).

This alternative is intended to provide the basis for including the SCLSs for the protection of non-coal resources. The SCLSs would be added to the other alternatives as a means of avoiding and mitigating impacts. The development scenarios for this alternative assumes that all minable coal would be recovered to the fullest extent using currently accepted industry practices. This alternative is not selectable because it is inconsistent with the Forest Plan, and would require a Forest Plan amendment. In addition, the selection of this alternative could result in potential environmental impacts to resources within the Pines Tract Project Area that could exceed Forest Plan impact thresholds.



MANTI-LA SAL NATIONAL FOREST PINES TRACT PROJECT		
FIGURE 2-1 ALTERNATIVE B		
SCALE 1"=4000'	DATE DRAWN 6/11/98	LAST REVISION 7/27/98

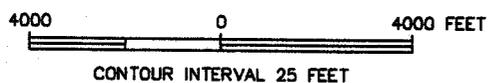
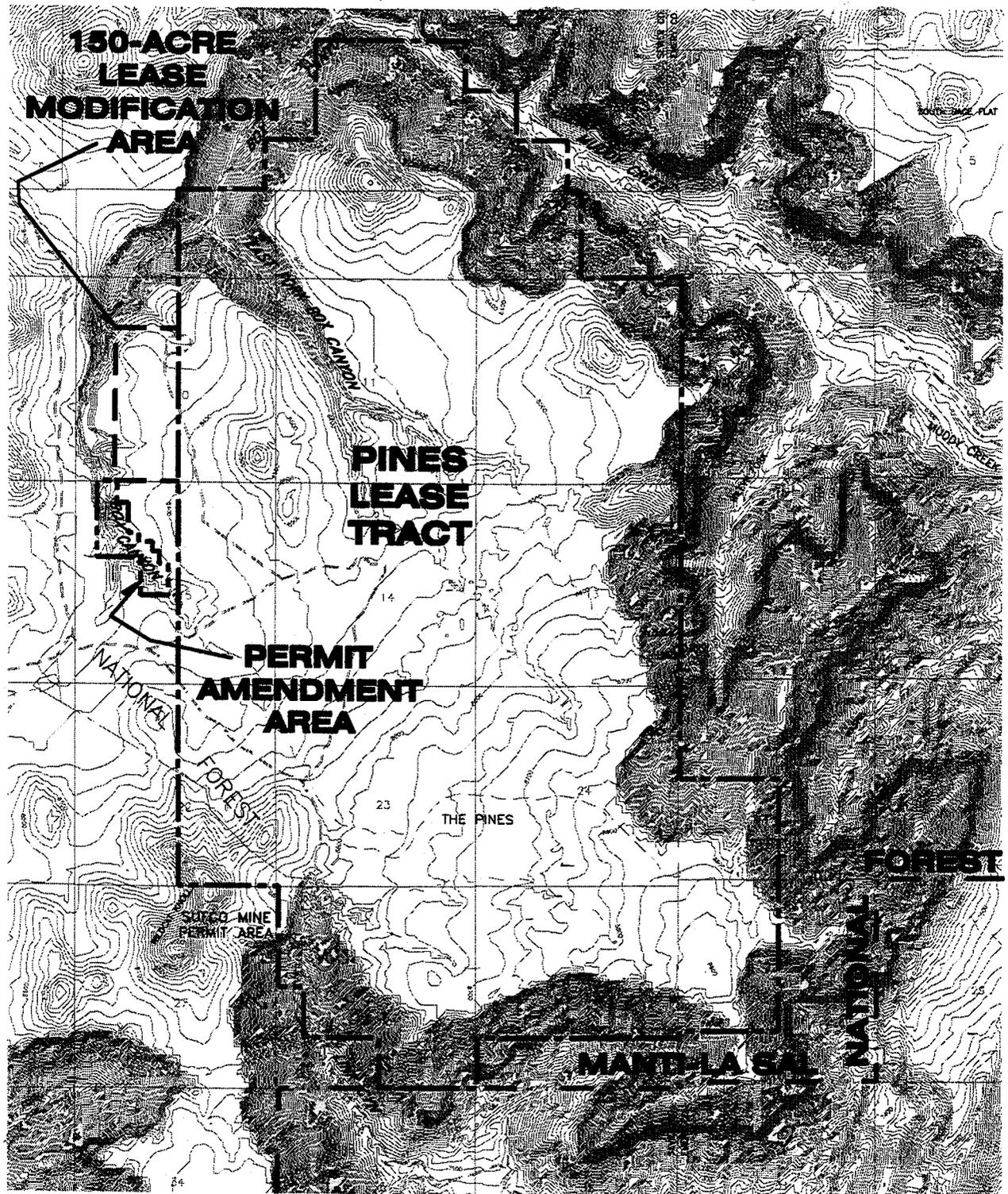
2.4.3 Alternative C -- Lease the proposed areas with Standard BLM Lease Terms and Conditions, and Special Coal Lease Stipulations for Protection of Non-Coal Resources (which would not allow subsidence of escarpments and perennial drainages in the analysis area)

This alternative addresses application of the Standard BLM lease terms and conditions, and the application of SCLSs for the protection of non-coal resources. Specifically, this alternative addresses issues identified through the application of the 18 SCLSs presented in the Forest Plan that are designed to lessen anticipated environmental effects. Additional stipulations relating to abandonment of equipment underground and MER would also apply. This alternative applies to the entire Project Area, as shown on Figure 2-2. This alternative is consistent with the Forest Plan. This alternative assumes that the successful applicant would conduct full extraction longwall mining for the majority of the Pines Tract Project Area. Mining that results in the subsidence would not be allowed in areas where perennial drainages and escarpments occur. Specifically, no mining that would cause subsidence would be allowed under the perennial streams and escarpments in Box Canyon or the East Fork of Box Canyon, or under the escarpments in Wiley's Fork and Link Canyon. A portion of the coal reserves in these areas would not be recovered.

The preferred alternative is best described as a modified Alternative C. The issue of subsidizing perennial drainages remains to be resolved, and the preferred alternative for this issue ranges from Alternative C to Alternative D. A more detailed discussion of the preferred alternative is given in Section VIII of the Executive Summary.

2.4.4 Alternative D -- Lease the proposed areas with Standard BLM Lease Terms and Conditions, and Special Coal Lease Stipulations for Protection of Non-Coal Resources, allowing subsidence of perennial drainages and escarpments in the analysis area

Alternative D includes mining that would allow subsidence of perennial drainages and escarpments as long as it would be consistent with laws, regulations, and Forest Plan direction. This alternative includes full extraction longwall mining under perennial drainages and escarpments within the analysis area. Specifically, this alternative allows mining that would cause subsidence under Box Canyon and the East Fork of Box Canyon. Current FS Stipulation #9 (in the Forest Plan) and Stipulation #13 (on the Quitchupah Lease), state that "except at specifically approved locations, underground mining operations shall be conducted in such a manner so as to prevent surface subsidence that would cause the creation of hazardous conditions such as potential escarpment failures and landslides, ..., and damage or alter the flow of perennial streams." The NEPA analysis performed for activities within the Quitchupah Lease did not analyze the undermining of streams and escarpments. Alternative D is consistent with the Forest Plan assuming that the effects would be consistent with Forest Plan direction and the FS designates perennial streams in Box Canyon and the East Fork of Box Canyon and some areas of escarpments as specifically approved locations. The area encompassed by this alternative is shown on Figure 2-2.



**MANTI-LA SAL NATIONAL FOREST
PINES TRACT PROJECT**

FIGURE 2-2
ALTERNATIVES C AND D

SCALE 1"=4000'	DATE DRAWN 6/11/98	LAST REVISION 7/27/98
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2.5 OTHER SCENARIOS CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

One scenario, a new mine at Muddy Canyon, was eliminated from detailed study because of the environmental and operational constraints. This scenario was based on the potential of a company other than Canyon Fuel acquiring the lease under the competitive bid process. Such an outcome would require alternative access other than that currently used by Canyon Fuel at the SUFCO Mine. Access through Muddy Canyon and the subsequent mine location was only briefly analyzed. It was determined that access to the Pines Coal Lease Tract through Link Canyon would be the better option. Access from the north via Muddy Canyon would be more difficult, and the coal access is more questionable due to the thinning of the coal and burn. In addition, development of a new mine at Muddy Canyon would entail more construction, equating to a greater amount of disturbance than the Link Canyon option. The potential of impacting Muddy Creek, the sole water supply for the Town of Emery, was also greater under the Muddy Canyon scenario. The RFDS developed by the BLM stated that development through Muddy Canyon was not feasible. Therefore, this scenario has been determined not to be a viable option, and will not be further analyzed in this EIS.

2.6 SUMMARY COMPARISON OF ALTERNATIVES RELATIVE TO ISSUES

Table 2.1 presents a summary comparison of resources potentially affected by each alternative. The information presented in this table is a summary comparison of the data presented in detail in Chapter 3 of this EIS. Potential effects to the environment resulting from the implementation of each alternative assume worst-case scenario. The effects identified in this table also assume that mitigation has been implemented.

2.7 PAST, PRESENT, REASONABLY FORESEEABLE FUTURE ACTIONS

CEQ regulations (40 CFR 1508.7) define cumulative impact as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonable foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions. Cumulative impacts can result from individuality minor but collectively significant actions taking place over a period of time.”

Past, present, and foreseeable future actions in the Pines Tract Project Area have been developed in support of the Draft EIS. The action, year of occurrence, and estimates of residual, current, or anticipated effects, if any, are presented in tables provided in Appendix B. Actions are grouped by resource. The sum of the effects of these actions, in addition to the anticipated direct and indirect effects of the proposed action, will form the basis for the cumulative effects analysis. Appendix B presents a summary of past, present, and reasonably foreseeable actions in the Pines Tract Project Area.

Table 2.1 Comparison of Alternatives

Resource Element/Issue	Alternative			
	A	B	C	D
GEOLOGY, TOPOGRAPHY, SUBSIDENCE:	No Effect	Up to 19.8 linear miles of escarpment could be subsided. Failures would likely occur in < 100 feet segments at isolated locations. Approx. 5 feet vertical subsidence. Arches & alcoves could be disturbed from subsidence.	No escarpments would be subsided, therefore no risk for failure or damage to alcoves or arches. Approx. 5 feet vertical subsidence. SCLS implemented.	Same impact as Alternative B; however, up to 22.5 linear miles could be subsided.
GROUNDWATER HYDROLOGY:	No Effect	Low to moderate potential to alter recharge paths to springs either causing flow increases or decreases. Low potential to affect water quality. Low potential for trans-basin diversion.	Reduced potential to alter springs since no subsidence of Box Canyon or East Fork. All else same as Alt. B. SCLS would require water replacement.	More springs could be subsided with low to moderate potential for altering recharge paths. All else same as Alt. B. SCLS would require water replacement.
SURFACE HYDROLOGY:	No Effect	High risk of diverting stream flow underground at Confluence Area - Main Fork. Moderate to high risk of intercepting flow in Upper East Fork Box Canyon. Moderate potential to crack and drain stock ponds. Inconsequential trans-basin diversions. Minimal water quality impacts.	No risk of diverting or intercepting stream flow. All else is same as Alt. B. SCLS would require water replacement.	Impacts to streams would be same as Alt. B but would include moderate to high risk of interrupting stream flows in Box Canyon. All else is same as Alt. B. SCLS would require water replacement.

Table 2.1 Comparison of Alternatives (cont.)

Resource Element/Issue	Alternative			
	A	B	C	D
SOILS:	No Effect	40 acres short term disturbance to soils from exploration; If a new mine is developed in Link Cyn, 100 additional acres of long-term disturbance to soils.	Similar impact as Alt. B. SCLS would be implemented, long term disturbance areas would be reclaimed upon cessation of mining to pre-mining land use.	Same impacts as Alternative B and C. SCLS would be implemented.
WILDLIFE:	No impacts associated w/ coal mining. Winter range for elk and mule deer could improve. Some species could benefit from vegetation treatments.	Loss of water in streams, springs or ponds, could alter riparian habitat important for sage grouse and macroinvertebrates, and reduce availability of live water sources for wildlife. Surface disturbance could remove 5 percent big game winter range. Escarpment failure could alter eagle and falcon nest locations. Up to 40 acres short-term habitat disturbance from exploration drilling.	Reduced potential for altering riparian habitat in perennial drainages. No risk to eagle or falcon nests. All else same as Alt. B.	Increased potential to lose water supporting riparian habitat in perennial drainages, thus increasing potential to reduce sage grouse and macroinvertebrate habitat. Increased risk to depleting live water sources.

Table 2.1 Comparison of Alternatives (cont.)

Resource Element/Issue	Alternative			
	A	B	C	D
VEGETATION:	Changes would result from actions taken to meet allotment management goals for livestock and wildlife.	Potential loss of 18.9 acres wetland/riparian vegetation and associated aquatic habitat; 40 acres short-term impact to other vegetation communities from exploration activities. If a new mine is developed in Link Cyn, 100 acres of long-term impact to vegetation.	SCLS would apply and would reduce potential impact to vegetation. Water sources lost would be replaced. Approx. 3 acres wetland/riparian habitats potentially impacted. Surface disturbance the same as Alt B, but would be reclaimed.	SCLS would apply, providing mechanism to protect wetland resources. Water sources lost would be replaced. Potential to impact 24.16 acres wetland/riparian vegetation. Surface disturbance the same as Alt C.
SPECIAL STATUS SPECIES:	No Effect	May affect- NLAA-Peregrine falcon, Colorado River fish species. May impact spotted bat, northern goshawk, flammulated owl, northern three-toed woodpecker. Will impact link trail columbine.	May impact northern three-toed woodpecker, link trail columbine. SCLS implemented, eliminate/reduce potential for impacts to these species.	Same impacts as Alt B. SCLS implemented, eliminate/reduce potential for impacts to these species.

Table 2.1 Comparison of Alternatives (cont.)

Resource Element/Issue	Alternative			
	A	B	C	D
LAND USE AND RECREATION:	Continued operation of SUFCO Mine. No new impacts.	New mine at Link Cyn could hinder recreational access. Low probability of injury to public land users due to escarpment failure. Future oil and gas leases could conflict with existing coal leases.	Reduction in impacts as Alternative B. SCLS applied. New mine at Link Cyn could hinder recreational access. No potential impact to public land users due to escarpment failure. Future oil and gas leases could conflict with existing coal leases.	Same impacts as Alt. B and C.
CULTURAL RESOURCES:	No Effect resulting from mining related actions; however, potential impacts may occur from recreational and livestock activities.	Six National Register eligible/unevaluated cultural resources could be affected by Level III or greater impacts.	None if the National Register eligible/unevaluated sites will be impacted by Level III or greater impacts.	Nine National Register eligible/unevaluated sites could be affected by Level III or greater impacts.
VISUAL RESOURCES:	No Effect	Potential for 19.8 miles of escarpment failure. Up to 40 acres surface disturbance resulting from exploration. If a new mine is developed in Link Cyn, up to 100 acres long-term surface disturbance.	No potential for escarpment failure. Up to 40 acres surface disturbance resulting from exploration. If a new mine is developed in Link Cyn, up to 100 acres long-term surface disturbance.	Potential for 22.5 miles of escarpment failure. Up to 40 acres surface disturbance resulting from exploration. If a new mine is developed in Link Cyn, up to 100 acres long-term surface disturbance.

Table 2.1 Comparison of Alternatives (cont.)

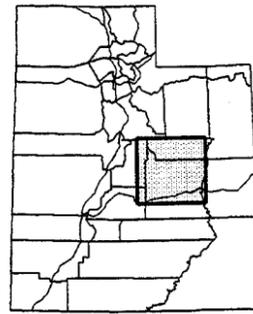
Resource Element/Issue	Alternative			
	A	B	C	D
AIR QUALITY:	The rate/impact of pollutants from SUFCO Mine would decrease to zero impacts when recoverable coal supply is depleted, year 2014.	Moderate increase in fugitive dust emissions. Increase in PM-10. Increase in particulate impact from loading.	Air pollution emission impact same as Alternative B, except for fugitive dust mitigative measures (SCLS) apply and impact would for a shorter duration (1 year less for Cyn Fuel/ 2 years for another mine).	Air pollution emission impacts similar as Alternative C.
SOCIOECONOMICS:	\$1.49 billion in coal value not realized. 230 jobs lost when SUFCO Mine closes in 14 years.	74.4 million tons coal recoverable. \$1.49 billion coal value realized. \$119 million government revenues.	64.5 million tons coal recoverable. \$1.29 billion coal value realized. \$103.2 million revenue.	76.6 million tons coal recoverable. \$1.53 billion recoverable coal, \$122.6 million in govt revenues.
TRANSPORTATION:	Haul traffic from SUFCO Mine would continue for 14 years at current rate.	Increase in truck traffic volumes. Surface related impacts to FS roads resulting from exploration activities (40 acres). Improvement of either Convulsion Cyn Road or Link Cyn Road.	Same impacts as Alt B, except truck traffic occurs for shorter duration. (1 year less for Cyn Fuel/ 2 years less for another mine).	Same impacts as Alt B, except truck traffic occurs for longer duration-2 years

Table 2.1 Comparison of Alternatives (cont.)

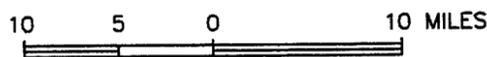
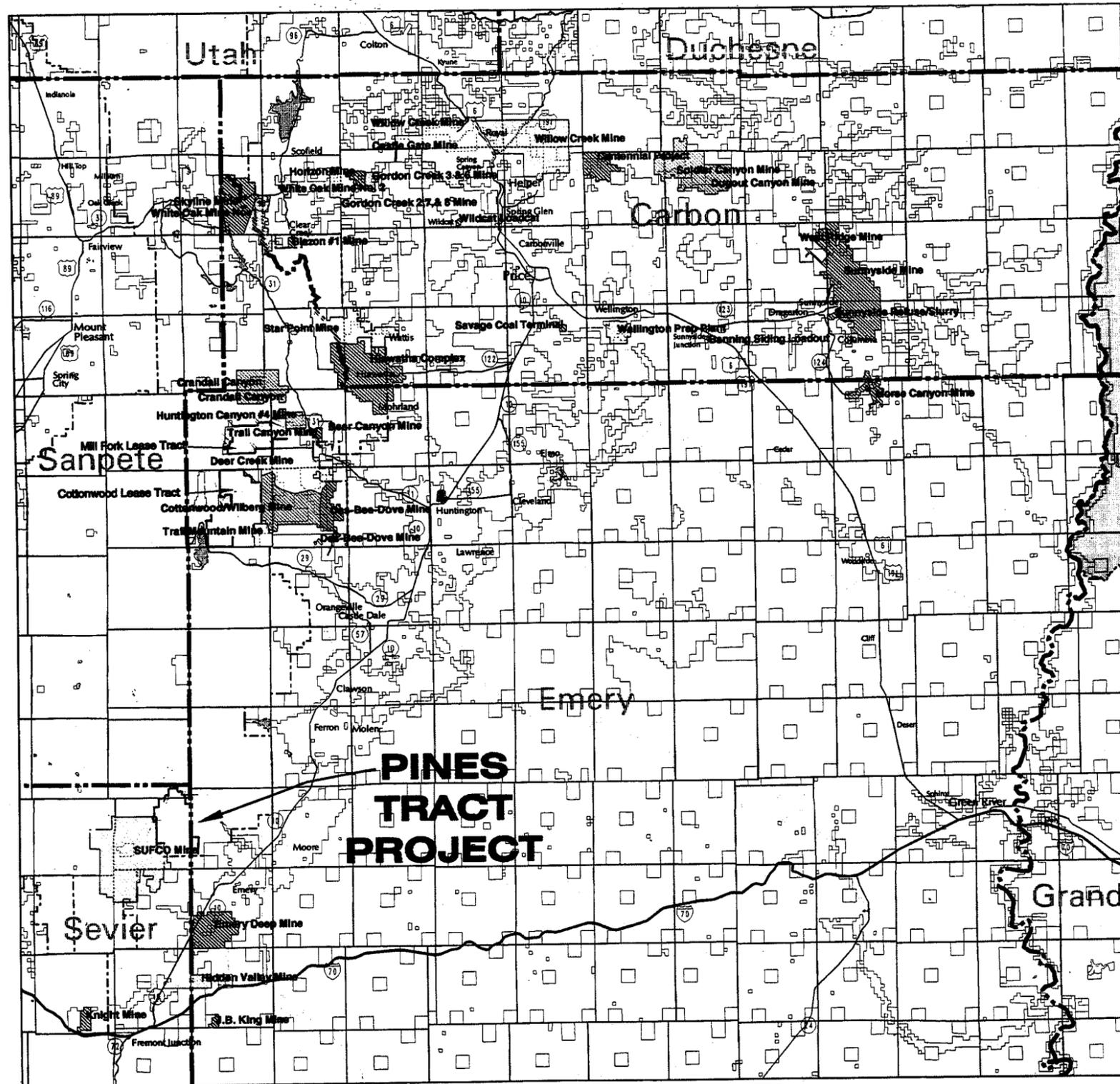
Resource Element/Issue	Alternative			
	A	B	C	D
RANGE:	Allotment managed according to AMP with emphasis on increasing forage, maintaining wildlife habitat, and implementing approved range improvements. No ponds have potential for impact.	Possible reduction of water available for livestock, possible reduction of AUMs for 1 to 5 years. Potential to block/restrict access to existing livestock trailing route. 9 ponds have potential for impact.	Similar impacts as Alt B except SCLS apply. Potential to block existing livestock routes. Possible reduction of AUMs from either exploration and/or new mine. 9 ponds have potential to lose water, replacement would be required.	Same impact as Alt C. SCLS apply. Potential to block existing livestock routes. Possible reduction of AUMs from either exploration and/or new mine. 9 ponds have potential to lose water, replacement would be required.

Figure 2-3 shows coal mining and coal related activity in the State of Utah. Active coal mining is not occurring elsewhere in the State. Figure 2-3 also presents the location of recent coal lease tracts and their proximity to the Pines Tract Project Area.

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Locator Map



ACTIVE COAL MINE PERMIT AREAS

- ACT007001 WHITE OAK MINE NO. 2
- ACT007001 WHITE OAK MINE NO. 1
- ACT007005 SKYLINE MINE
- ACT007006 STAR POINT MINE
- ACT007018 SOLDIER CANYON MINE
- ACT007019 CENTENNIAL PROJECT
- ACT007020 HORIZON MINE
- ACT007038 WILLOW CREEK MINE
- ACT007039 DUGOUT CANYON MINE
- ACT015009 TRAIL MOUNTAIN MINE
- ACT015018 DEER CREEK MINE
- ACT015019 COTTONWOOD/WILBERG MINE
- ACT015025 BEAR CANYON MINE
- ACT015032 CRANDAL CANYON
- ACT041002 SUFCO MINE

INACTIVE COAL MINE PERMIT AREAS

- ACT007004 CASTLE GATE MINE
- ACT007007 SUNNYSIDE MINE
- ACT007016 GORDON CREEK 2, 7, & 8 MINE
- ACT007017 GORDON CREEK 3 & 6
- ACT007021 BLAZON #1 MINE
- ACT015002 J.B. KING MINE
- ACT015004 HUNTINGTON CANYON #4 MINE
- ACT015007 HIDDEN VALLEY MINE
- ACT015021 TRAIL CANYON MINE
- ACT041005 KNIGHT MINE

INACTIVE/TEMPORARY CESSATION COAL MINE PERMIT AREAS

- ACT015015 EMERY DEEP MINE
- ACT015017 DES-BEE-DOVE MINE

INACTIVE/LIKELY TO BE ACTIVE WITHIN THE YEAR COAL MINE PERMIT AREAS

- ACT007011 HIAWATHA COMPLEX
- ACT007012 WELLINGTON PREP PLANT
- ACT007013 HORSE CANYON MINE
- PRO007041 WEST RIDGE MINE

OTHER COAL MINE PERMIT AREAS

- ACT007022 SAVAGE COAL TERMINAL
- ACT007033 WILDCAT LOADOUT
- ACT007034 BANNING SIDING LOADOUT
- ACT007035 SUNNYSIDE REFUSE/SLURRY

FEDERAL COAL LEASES

- MILL FORK LEASE TRACT
- COTTONWOOD LEASE TRACT

**MANTI-LA SAL NATIONAL FOREST
PINES TRACT PROJECT**

FIGURE 2-3
COAL ACTIVITY IN REGION INCLUSIVE OF
WASATCH PLATEAU, BOOK CLIFFS, AND
EMERY COAL FIELDS

Source: State of Utah Department of Natural Resources Division of Oil, Gas and Mining, "Public Records State of Utah, Coal Mine Locations", March 23, 1998

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

FOREST PLAN DIRECTION

This chapter presents a description of the affected environment, which is presented by individual resource elements. Environmental consequences resulting from the implementation of each alternative and relating to each resource element are also presented in this chapter, in conjunction with the cumulative analysis. Appendix B presents a summary of past, present, and reasonably foreseeable future actions in the Pines Tract Project Area. Analysis in this chapter reference the Final Pines Tract Project EIS Technical Reports (JBR 1998d) which are kept in the FS MLS Project File.

The Forest Plan guides all natural resource management activities and establishes management standards and guidelines for the MLS (USDA-FS 1986a). The Forest Plan describes resource management Standards and Guidelines and provides Goals and Objectives. Appendix C presents the Standard BLM Lease Terms and Conditions. Appendix D presents the Special Coal Lease Stipulations.

Management direction in the Forest Plan is a direct result of identified public issues, management concerns, and management opportunities. Proposed uses on forest lands, such as the Pines Coal Lease Tract, must be consistent with management requirements of the Forest Plan. Multiple use general management directions, as designated by the Forest Plan (pages III-64 to III-76) for the Pines Tract Project Area, are summarized below.

- TBR- Emphasis is on wood-fiber production and harvest. This includes areas with timber stands capable of producing high value wood products. Inclusions of other vegetative types occur that may be managed for other uses. Other uses occur so long as the use or its rehabilitation return the area to a condition that is in harmony with the timber emphasis.
- RNG- Emphasis is on production of forage and cover for domestic livestock and wildlife. Intensive grazing management systems are generally favored. Range condition is improved or maintained through range and/or silvicultural improvement practices, livestock management through a grazing system, and coordination with other resource activities. Some periodic heavy forage utilization may occur. Opportunities for investments in structural and non-structural improvements to increase forage production is moderate to high.

- MMA- Emphasis is on leasable mineral development. This includes areas where the land surface is or will be used for facilities needed for an extended period in the extraction of leasable minerals. Other resource uses may occur. Long-term investments in other resources or their use will not be made until extraction is complete and the area is rehabilitated to other uses.
- GWR- Emphasis is on general big game winter range. These are areas that wildlife traditionally use in winter. Other uses may occur so long as they do not conflict with or cause unacceptable stress on wildlife, and so long as the activity or its rehabilitation emphasizes habitat maintenance or enhancement.
- RPN- The RPN unit is not delineated in the Forest Plan but management direction requires analysis of RPN units on site-specific project basis. The RPN unit emphasizes management of riparian areas and component ecosystems, including aquatic and riparian communities that occur within 100 feet of perennial streams, springs, seeps, bogs, and wet meadows. The goals of management are to: “1) maintain water flows to provide free and unbound water within the soil needed to create the distinct vegetative community, 2) provide healthy self-perpetuating plant communities, 3) meet water quality standards, 4) provide habitats for viable populations of wildlife and fish, 5) provide stable stream channels and still water body shorelines, and 6) restore riparian habitats that have been lost through the downcutting of stream channels and wet meadows. With specific regard to mineral management activities in an RPN area, the Forest Plan calls to “avoid and mitigate detrimental disturbance to the riparian area, and initiate timely and effective rehabilitation of disturbed sites, and where possible, to locate mineral activities outside the riparian unit, and to design and locate settling ponds to prevent washout in high water.”

3.1 TOPOGRAPHY, GEOLOGY, AND SUBSIDENCE

3.1.1 Affected Environment

The Pines Tract Project Area is located in the southern Wasatch Plateau Coalfield, within the Wasatch Plateau Subprovince of the Colorado Plateau Physiographic Province. The Wasatch Plateau trends north-south and is bounded by Sanpete Valley to the west and Castle Valley to the east. Regional topographic features and geology are shown in Figures 3-1 and 3-2.

Subsidence includes both vertical and horizontal deformations of the ground surface due to mining. The analysis area; the Pines Coal Lease Tract; the 150-acre Lease Modification Area; and the Box Canyon Proposed Subsidence Area within the existing Quitchupah Lease Tract could be directly affected by subsidence from proposed mining.

Topography

Topography within the Project Area is varied. The top of the Wasatch Plateau in the Project Area is a relatively flat to rolling tableland with elevations close to 9,000 feet above mean sea level (MSL). Ephemeral gullies drain the plateau, feeding canyons incised into the predominantly sandstone strata exposed at the brink of the canyons. Overall, the top of the Wasatch Plateau slopes gently toward the west.

Canyons typically dissect the plateau surface, commonly in a pattern dictated by the geologic structure. Four canyons lie, in part, within the Project Area: Muddy Creek, Link, Box, and East Fork of Box Canyon. Relief in the canyons range from less than 100 feet (upper Box Canyon) to greater than 1,000 feet for the larger canyons such as Muddy Creek and Quitchupah Canyons. Generally, canyon walls are steep and canyon bottoms are relatively narrow, formed as a result of regional uplift and stream downcutting through the horizontally bedded strata. Colluvial toe slopes are common, as are localized areas of rockfall.

Horizontal bedding planes, natural jointing, and erosion provide for local topographic variation in a landscape dominated by the exposure of the cliff-forming Castlegate Sandstone. The canyon slopes are typically comprised of a series of cliffs and ledges, overlain in spots by rockfall and talus slopes. The talus and soil formation mediates the topography by minimizing the cliff/ledge contrasts. Spalling of sandstone cliffs also contributes to a varied topography. Aspect is another component of topography, as it affects weathering, soil formation and vegetation; a marked contrast in north-facing and south-facing slopes is typical in the Project Area.

In the Main Fork of Box Canyon within the Project Area, cliffs average about 70 feet and the canyon walls are approximately 150 feet tall at the deepest point. In the East Fork of Box Canyon, maximum cliff height is approximately 200 feet.

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EXPLANATION

- PINES LEASE TRACT BOUNDARY
- 150-ACRE LEASE MODIFICATION AREA BOUNDARY
- PERMIT AMENDMENT AREA BOUNDARY

GEOLOGY

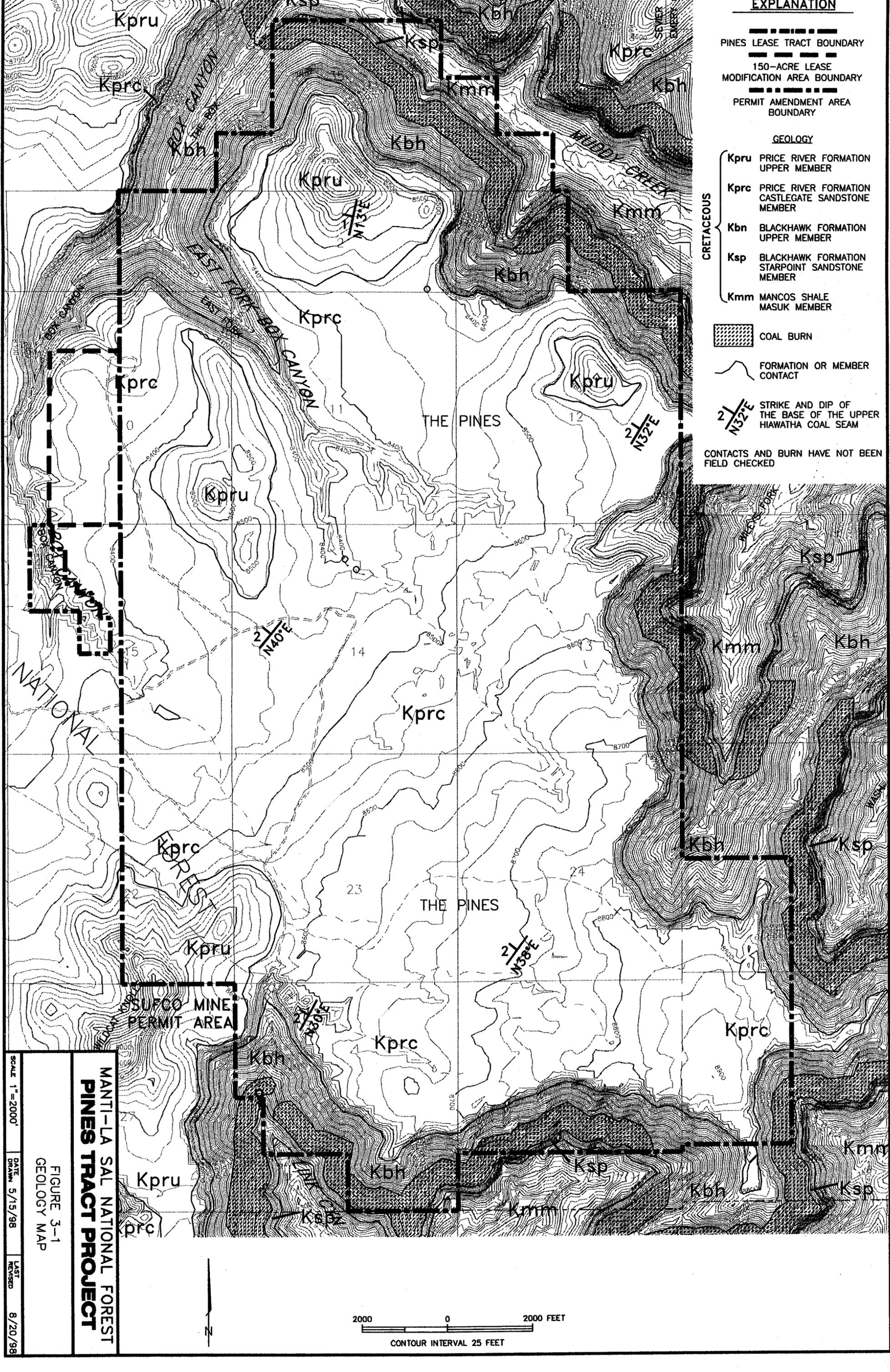
- CRETACEOUS**
- Kpru PRICE RIVER FORMATION UPPER MEMBER
 - Kprc PRICE RIVER FORMATION CASTLEGATE SANDSTONE MEMBER
 - Kbn BLACKHAWK FORMATION UPPER MEMBER
 - Ksp BLACKHAWK FORMATION STARPOINT SANDSTONE MEMBER
 - Kmm MANCOS SHALE MASUK MEMBER

COAL BURN

FORMATION OR MEMBER CONTACT

STRIKE AND DIP OF THE BASE OF THE UPPER HIAWATHA COAL SEAM

CONTACTS AND BURN HAVE NOT BEEN FIELD CHECKED



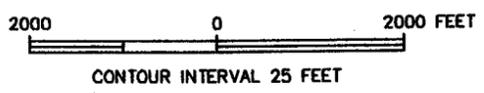
**MANTI-LA SAL NATIONAL FOREST
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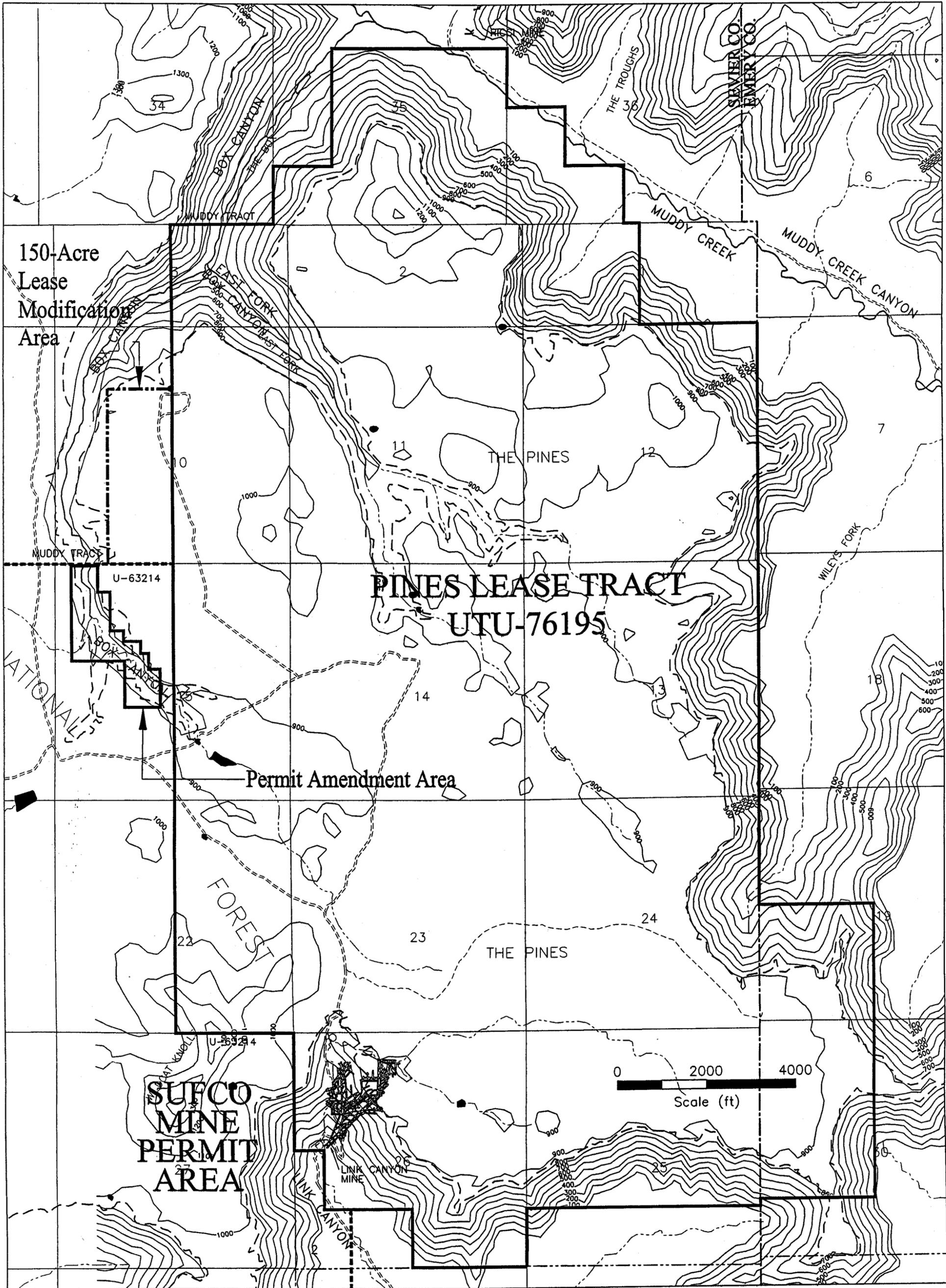
FIGURE 3-1
GEOLOGY MAP

SCALE 1"=2000'

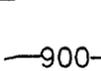
DATE DRAWN 5/15/98

LAST REVISED 8/20/98





Legend

-  Escarpment
-  Lease Boundary
-  900 — Upper Hiawatha Coal Seam Overburden (ft)

**MANTI-LA SAL NATIONAL FOREST
PINES TRACT PROJECT**

FIGURE 3-2
UPPER HIAWATHA
COAL SEAM OVERBURDEN

SCALE AS SHOWN DATE DRAWN 4/9/98 LAST REVISION 7/28/98

Drainage from the Pines Plateau is predominantly from southeast to northwest, eventually draining into Box Canyon which cuts across the northwest corner of the tract. Box Canyon drains northward into Muddy Creek which, eventually flows southeast toward the town of Emery.

Geology

A generalized geologic section of the Pines region is shown in Figure 3-3. All rock units within the Project Area are sedimentary. Most of the exposed rocks were deposited during the Cretaceous Age of the Mesozoic Era, along the margin of the Western Interior Cretaceous Seaway. Regressions and transgressions of this seaway have resulted in a heterogeneous sequence of rock types that are both horizontally and vertically discontinuous. The oldest unit is the Upper Cretaceous Masuk Member of the Mancos Shale. That unit is overlain (in order of increasingly younger rocks) by the Star Point Sandstone, interbedded coal, shales and sandstones of the Blackhawk Formation, the Castlegate Sandstone, and portions of the Upper Member of the Price River Formation. These units represent an overall regressive sequence of depositional environments: marine (Mancos Shale); littoral (Star Point Sandstone); lagoonal (Blackhawk Formation); and fluvial (Price River and North Horn) (UDOGM 1989). Each rock unit is described below. The Upper North Horn Formation (lower Tertiary in age) is thought to be eroded away over most of the Project Area (Thiros and Cordy 1991). Small remnant sections may remain, capping the highest hills.

Mancos Shale—Masuk Member. The Masuk Member of the Mancos Shale outcrops along the eastern edge of the Wasatch Plateau, including that portion of the plateau in which the Project Area occurs. Along the plateau, the Masuk Member's thickness varies from 300 feet to 1,300 feet, thinning from north to south and from east to west. The Masuk Member is probably about 500 feet to 600 feet in Muddy Creek Canyon, along the north side of the Project Area.

The Masuk Member is the lowest rock unit exposed in the Project Area. It consists of blue-gray shale or silty claystone that weathers light blue-gray to light tan. The unit contains thin calcareous sandy or silty interbeds which increase in frequency toward the top of the unit. The interbeds are usually light tan to yellow, and in places their weathering gives the Masuk a light tan cast. The Masuk Member comprises the lower slopes of Box and Muddy Creek Canyons. It forms steep, barren, and easily eroded slopes with occasional ledges of more resistant, fine-grained sandstone, siltstone, or sandy claystone.

Star Point Sandstone. The Star Point Sandstone is almost continually exposed in outcrop for approximately 100 miles along the eastern edge of the Wasatch Plateau, including the Project Area. Although in some areas of the plateau its thickness reaches 1,000 feet, within the Project Area it is estimated to be only about 200 feet thick. The upper Star Point Sandstone consists of three massive sandstone layers, the uppermost of which intertongues with the Blackhawk Formation (Thiros and Cordy 1991). The lower Star Point Sandstone is an upward prograding sequence of thin sandstones, siltstones, and shales that intertongue with the underlying Masuk Member of the Mancos Shale. The thickness of the Star Point Sandstone is 280 feet.

Geologic Period	Formation	Lithology	Thickness (ft)	Description
CRETACEOUS	Price River Formation			Conglomerate, sandstone, siltstone, shale
		Castlegate Sandstone	200	Massive, tan, cliff-forming fluvial sandstone minor shale, siltstone and conglomerate
	Blackhawk Formation	829	60-65% sandstone with remainder shales, siltstones, mudstones and coal seams	
	Star Point Sandstone	250	White massive sandstone with shale interbeds	

Upper Hiawatha Seam

Legend

-  Shale
-  Mudstone, siltstone and shale interbedded
-  Sandstone
-  Coal

**MANTI-LA SAL NATIONAL FOREST
PINES TRACT PROJECT**

FIGURE 3-3
GENERALIZED LITHOLOGIC COLUMN
FOR THE PROJECT AREA

SCALE NTS	DATE DRAWN 4/9/98	LAST REVISION 7/28/98
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The top surface of the Star Point Sandstone is nearly planar in the area of the existing SUFCO Mine; northeast of the mine in the Link Canyon and Muddy Creek area, it intertongues with the overlying sediments of the Blackhawk Formation.

The Star Point Sandstone is a tan- to gray-colored, fine- to medium-grained, friable, and usually well-sorted sandstone, with minor thin interbeds of siltstone or claystone. In places, the upper few feet are bleached white. This unit contains trace fossils, and siltstones and shales in the unit are intensely bioturbated. The Star Point Sandstone is a coastal complex of distributary channel, delta front, and beach barrier sediments. It is a massive cliff-forming unit near the Project Area, and has created a nearly unbroken ledge along Convulsion Canyon and North Fork Quitcupah Canyon.

Blackhawk Formation. The Upper Member of the Blackhawk Formation is well exposed along the front of the Wasatch Plateau, and in canyons cutting the plateau. In the Project Area, it is exposed in Box and Muddy Creek Canyons. The Blackhawk Formation varies in thickness from 400 feet, south of John's Peak, to 1,750 feet in the Pleasant Valley area, with a general thickening from east to west; within the Project Area it is approximately 630 feet thick (Goodrich and Agapito 1997).

The Blackhawk Formation consists of interbedded alluvial plain and marginal marine deposits of sandstone, siltstone, claystone, and coal. The finer-grained rocks in the Blackhawk can contain abundant swelling clays (Mayo and Associates 1997b). Approximately 60 percent to 65 percent of the total thickness of the Blackhawk Formation is sandstone, with the remainder comprised of siltstone, mudstone, shale, and coal. The upper 500 feet of the formation has massive, fine- to medium-grained, cliff-forming sandstone units. These sandstones were deposited in delta and flood plain environments and are isolated from each other both laterally and vertically by mud-rich overbank and low-flow deposits. The lower 300 feet of the formation contains thinly bedded sandstone and shale layers deposited in a marine shoreface and foreshore depositional environment.

Most of the coal seams in the Blackhawk Formation occur in the lower 200 feet, with the thicker coal seams occurring in the lower 150 feet. These coal seams, with thickness greater than 5 feet (the Upper Hiawatha Seam and two others of lesser importance [the Lower Hiawatha Seam and the Duncan Seam]), are found in the Blackhawk Formation within the Project Area (Smith 1981). The upper Hiawatha Seam is the only one of the three that is continuous and sufficiently thick within the Pines Coal Lease Tract boundaries to be considered minable. This seam has a thickness of between 7 and 18 feet over most of the Project Area. The Lower Hiawatha Seam occurs in the interval between the Upper Hiawatha Seam and the Star Point Sandstone. The interval between the two coal seams varies, and ranges between 11.5 and 60 feet. The Lower Hiawatha Seam is thin and discontinuous, varying in thickness from 1.5 to 5.5 feet. The Lower Hiawatha Seam is only considered to be minable where the interburden between the Upper Hiawatha Seam is greater than 30 feet.

The third coal seam occurs 100 feet to 130 feet above the Upper Hiawatha and has been informally named the Duncan Seam by Canyon Fuel. This seam is not considered minable because it is of such limited lateral extent and does not attain minable thickness.

In Box and Muddy Creek Canyons, there are large areas where the coal has burned naturally near the outcrops and baked the rocks above to form a resistant reddish clinker layer. These areas are generally steeper than the surrounding slopes. Vegetative cover is generally sparse, so the burned strata can be easily recognized except on some north-facing slopes where the vegetation masks the burn. The lateral extent of these burned coal seams is probably about 800 feet.

Price River Formation—Castlegate Sandstone Member. Castlegate Sandstone Member of the Price River Formation. The Castlegate Sandstone forms the cap rock of much of the plateau in the Project Area and the steep cliff escarpment surrounding the plateau. It is predominately massively bedded, coarse-grained sandstone with some interbeds of shale, siltstone, and conglomerate. Pervasive silica and carbonate cement makes the formation well indurated and brittle. Within the Main Fork of Box Canyon the Castlegate Sandstone is typically 200 feet thick. However, throughout most of the canyon, commonly less than 60 to 100 feet of the formation is exposed, forming the rims and walls of Box Canyon (Goodrich and Agapito 1997). The thickness of the sandstone where it underlies the streambed of the Main Fork of Box Canyon is approximately 30 feet near the stream's headwaters to about 200 feet near the lease boundary.

Upper Price River Formation. The Price River Formation is the uppermost member of the Mesa Verde Group. It forms low-lying hills on the plateau. The member is reported to be approximately 550 feet thick in the SUFCO Mine area, but has been partially to wholly eroded away in the Project Area. Thiros and Cordy (1991) report that this formation is present in only about 25 percent of the Pines Coal Lease Tract and is found mostly in the northern portion of the Pines Coal Lease Tract. The formation consists of medium- to coarse-grained sandstone, interbedded shale, and some thin beds of conglomerate. This formation was deposited by fluvial systems. Mudstone drapes deposited during low-flow periods separate fluvial sandstones from each other both horizontally and vertically. The formation is resistant to weathering and is a ledge- and slope-former due to interbedding of resistant sandstones with less resistant shales and claystones.

Coal Geology. The coal to be extracted from the Project Area occurs in the lower portion of the Blackhawk Formation. Although elsewhere identified as the Upper Ivie Bed, it is herein referred to following Canyon Fuel's designation as the Upper Hiawatha Seam.

The Upper Hiawatha coal seam has a fairly uniform thickness of 10 to 18 feet except in the southeast corner of the Project Area where it is in the range of 4 to 9 feet. Within the Permit Amendment Area, the minable coal seam is approximately 775 feet below the Castlegate Sandstone (Goodrich and Agapito 1997).

All other seams found are less than 5 feet thick and/or there is less than 30 feet of interburden between the Upper Hiawatha Seam and any other potentially minable seam. The two cases where there is minable coal in a second seam are not justifiable for mining due to the capital costs required to develop and mine the very small areas.

Structural Features—Location and Displacement Along Faults. The Project Area lies just west of the Joe's Valley-Paradise Fault Zone. Rock units in the mine area strike at roughly N40°E, and dip 1 to 2 degrees (about 250 feet per mile) to the northwest. Local dips of the coal seam may range up to 10 degrees in areas where underlying paleochannels caused differential compaction.

Small faults (apparent vertical displacement of about 3 feet or less) and some of greater displacement have been encountered in the SUFCO Mine. These faults most commonly strike approximately N10°W to N15°W and are near vertical. Joints occur parallel and normal to the fault trend. Both faults and joints are expected in the Project Area, but no faults are known at this time.

Minor faults have been identified within the Permit Amendment Area (Mayo and Associates 1997b). Within the Main Fork of Box Canyon, the dominant joints trend N21°W, which is essentially the same orientation as the Canyon itself. Mapping indicates these joints generally range in spacing from 16 to 33 feet, although spacing is reduced to approximately 6 to 10 feet in Castlegate Sandstone exposures near the head of Box Canyon. Continuity of mapped joints varies from 200 feet to 950 feet. This predominant joint set is readily visible in the rock outcrops near the brink of Box Canyon and the East Fork of Box Canyon in aerial photos. Minor joint sets also strike N69°E, N15°E, and N39°W (Canyon Fuel 1996a).

Overburden Data. Overburden above the Upper Hiawatha Seam varies from 0 feet at the outcrop to 1,000 feet at the north end of the Project Area. Generally, overburden is in the 900- to 1,000-foot range once the Castlegate Sandstone escarpment is reached, as shown in Figure 3-2.

Previous Mining within the Project Area. Previous mining within the Project Area includes the SUFCO Mine in the Quitchupah Lease and the abandoned Link Canyon Mine. Longwall mining and room-and-pillar mining are currently being conducted in the SUFCO Mine. In most of the room-and-pillar sections, secondary recovery of the pillars is practiced. Subsidence of approximately 4 feet to 5 feet have been observed over the longwall portions of the SUFCO Mine. Where high extraction has been conducted out from under the Castlegate Sandstone escarpment, subsidence magnitudes have been up to 7 feet.

In the Link Canyon Mine, coal was produced from the Upper Hiawatha Seam using room-and-pillar partial-extraction mining. The workings encompass less than 40 acres beneath Link Canyon in the southern portion of the tract. Figure 3-2 shows the location of the Link Canyon Mine in relation to the Project Area. The presence of the existing Link Canyon Mine is not expected to

have any influence on subsidence other than precluding future mining in the immediate vicinity of Link Canyon. A buffer surrounding the existing workings of approximately 270 feet is foreseeable. The buffer distance of 270 feet is based on the angle of draw of 15° and the depth of cover of approximately 1,000 feet.

Future Mining within the Project Area. Future coal production in the Project Area is predicted to be by full-extraction longwall mining. Longwall mining is suitable for the known geologic conditions and offers superior economic advantages over other existing mining methods. The RFDS assumes panels would be most favorably oriented north-south to maximize panel length, although panels of other orientations are possible. An optimal and achievable near-future mine plan would include longwall panels nominally 1,000 feet wide and as much as 19,000 feet long (see Section 1.5).

Longwall mining height will likely be dictated by shield operating range and Upper Hiawatha Seam coal thickness. Over most of the planned mining area, including the areas most vulnerable to subsidence damage, longwall heights are expected to range from 11 feet to 12 feet, although mining heights of 14 feet are possible with longwall equipment currently employed in some western United States coal mines. Gateroads are anticipated to range from 9 feet to 10 feet tall. Lower face and gateroad heights could occur, particularly to the southeast, where the seam splits and thins. Coal seam thickness and coal quality issues, ultimately, will dictate mining heights.

The reasonable foreseeable mine plan assumes longwall mining with a 1,000-foot wide face and a 3-entry gateroad design with rigid pillars. This is motivated, in part, by the need for economic competitiveness and by the favorable geologic conditions. The mining geometries described above are believed to be reasonably representative of the most probable future mining scenarios and serves as a basis for predicting potential subsidence impacts (BLM 1998).

The gateroad design currently used in the SUFCO Mine and proposed for the Project Area longwall panels employs rigid- or abutment-type pillars that remain essentially intact after retreat of the adjacent longwall panels. These pillars are not designed to yield or crush as this analysis assumes a three-entry gateroad system with large, rigid pillars. As a result, subsidence tends to be less above rigid-pillar gateroads than above yield-pillar gateroads. Yield-pillar gateroads are used at a number of deep coal mines in the Wasatch Plateau and Bookcliffs Coalfields and could be employed with future mining in the Project Area. Additional analyses would be needed if the gateroads were changed to a two-entry system.

This type of plan represents the reasonably foreseeable mining (RFDS) scenario for the Project Area and serves as the basis for discussing potential subsidence-related impacts throughout this section (see Section 1.5). More detailed analysis is in the Final Geology, Topography, and Subsidence Technical Report (Agapito Associates 1998) contained in the FS MLS project file.

Escarpmnts. A natural tendency exists for fractures to open parallel and subparallel to cliff faces, even in the absence of mining. Natural joints often preferentially form parallel to canyon walls as the result of a gradual release of horizontal stress with canyon erosion. Consequently, cliffs are oftentimes inherently unstable and can be particularly susceptible to subsidence-induced toppling failures. Blocks in a cliff face are prone to sliding along natural joints, bedding planes, and weak foundation strata. This process is further exacerbated by water infiltration into natural joints leading to failures caused by hydrostatic pressure and/or frost wedging. This process develops over the course of geologic time (i.e., hundreds to thousands of years) compared to the short duration of mining, which lasts only decades.

Stability of the Castlegate Sandstone escarpments in the Pines locality are controlled by numerous factors. Some of these factors are: orientation (aspect) of the cliff face, height of the cliff face, exposure of underlying weak foundation strata, structure (joint set orientations and spacing), and concavity/convexity of the cliff face.

Erosion of the Blackhawk Formation, comprising the foundation of most of the Castlegate Sandstone cliffs, can lead to increased tension in the overhanging rock, thus creating additional natural fractures and expanding existing ones. Greater exposure of the Blackhawk Formation (i.e., greater canyon depth), increases the likelihood of this occurrence.

Test mining under the Castlegate Sandstone escarpment has been conducted at the SUFCO Mine to gain an understanding of the sensitivity of area cliffs to mining-induced subsidence (Dimick 1991). Originally, pillars were extracted from room-and-pillar workings beneath two escarpment areas. The following excerpt from the Canyon Fuel PAP (MRP) (1996a) describes the test mining:

“...These areas involved a 5,000-foot section of escarpment on Federal lease (SL-062583) in East Spring Canyon (1977-78) and 2,000 feet of escarpment on Fee property (1983-88) on the east side of Quitchupah Canyon. Following pillar removal from the East Spring Canyon area, tension cracks were found around the perimeter of the canyon. Most of these cracks followed natural joints which were temporarily amplified by subsidence.

A similar pattern of tension cracks occurred above the three room-and-pillar panels in Quitchupah Canyon. There were no slope failures, but one incidence of cliff spalling occurred...”

The collapse of large blocks were responsible for scour areas and vegetation removal from the talus slopes below the cliffs. Falling blocks could present a hazard to people and wildlife in the immediate vicinity. In addition, the Twin Bridges arch located on the brink of Quitchupah Canyon in the Castlegate Sandstone collapsed during pillar recovery operations.

From the observations in Quitchupah Canyon, predictions of escarpment conditions for the Project Area can be developed. Escarpment response to longwall subsidence is expected to be similar to that observed in Quitchupah Canyon for escarpments bounding the Pines Tract Project Area, where the Castlegate cliffs are of comparable height. Cliff height is the predominant feature controlling stability in the region. These escarpments define the fringes of the Pines Plateau and are hereafter referred to as "perimeter escarpments," in contrast to the "interior escarpments" in Box Canyon and the East Fork of Box Canyon (see Figure 3-19).

For Box Canyon and the East Fork of Box Canyon, notable differences exist from the character of the perimeter escarpments in Quitchupah Canyon. The primary differences stem from the differing canyon depths. Canyon depth affects both the height of the cliff face and the amount of exposure of the underlying weak foundation strata.

Important distinctions regarding Box/East Fork of Box Canyons (interior) and Quitchupah Canyon (perimeter) cliffs are:

At its deepest point in the Project Area, Box Canyon is approximately 150 feet. At this point, the underlying Blackhawk strata are still located beneath the streambed. The East Fork of Box Canyon reaches approximately 800 feet deep within the Project Area. In contrast, Quitchupah Canyon varies from 1,000 feet to 1,400 feet deep in the test mining vicinity.

The cliff faces in Box Canyon and the East Fork of Box Canyon are more convex-shaped with increased curvature near the tops of the canyon walls. Quitchupah Canyon cliffs are generally more linear, thus more susceptible to slabbing.

Cliff face aspect is an important parameter in cliff face erosion rates, which affects natural stability. In the Pines region, cliffs with southern aspects tend to erode more rapidly than those with northern aspects. This is because of the more extreme climatic differences caused by increased sun exposure, on southern aspect faces. The cliff face aspect and exposure to sun affect available moisture, vegetation, slope, and soil formation. Quitchupah Canyon cliffs exhibit a generally southern exposure in contrast to Box Canyon and the East Fork of Box Canyon, which exhibit a more eastern and western exposure.

Cliff concavity or convexity typically is controlled by cliff height and exposure of the weaker, foundation strata. A convex slope, rather than a cliff, is indicative of the natural tendency for the slope to decline in angle. Given time, rocks will erode flat rather than form vertical exposures. The Castlegate Sandstone will tend to erode to a slight convex shape until undercutting is permitted by incision into the underlying Blackhawk Formation strata. As the rate of streambed incision increases, the slope of the cliffs become more vertical as the decline-in-slope processes fail to keep pace.

In geomorphologic situations such as Quitchupah Canyon, where the weaker, underlying strata of the Blackhawk have been exposed, erosion is controlled by the process of weathering and removal of the talus and interbedded shales, sandstones, siltstones, and coal beds. Once undercutting into the Blackhawk Formation is achieved, the predominant erosional processes become slab failures, where large amounts of material may be removed in events lasting only seconds. By virtue of the shallower depths of Box Canyon and the East Fork of Box Canyon, undercutting into the Blackhawk Formation is expected to be nonexistent to far less pronounced than in Quitchupah Canyon (Goodrich and Agapito 1997).

These combined factors suggest that cliffs in Box Canyon and the East Fork of Box Canyon should be less susceptible to mining-induced instability compared with the observations made during test mining in Quitchupah Canyon.

Baseline Subsidence Survey Data. Subsidence data have been collected at the SUFCO Mine since 1976. These baseline data are relevant to predicting potential subsidence within the Project Area because geologic and mining conditions, as well as the mining method, will likely be similar. Surface behavior documented in previous SUFCO Mine surveys provides the most definitive basis for predicting future subsidence features. Since 1985, subsidence data have been collected by photogrammetric survey techniques. Aerial surveys are taken each year and new elevations are determined on an approximate 200-foot grid (Canyon Fuel 1996b). Accuracy of vertical surface movement from aerial photos is generally about ± 0.5 feet.

Annual SUFCO Mine subsidence reports for the years 1991 through 1996 chronicle subsidence trough development and provide information pertaining to control monuments, overburden contours, subsidence contours, surface tension cracks, development, and mine projections. Maximum subsidence was approximately 4 to 5 feet over longwall panels. Peak subsidence is expected to be about 5 feet above panels in the Pines Coal Lease Tract because: 1) panel width will increase from 670-710 feet to 1,000 feet, and 2) depth of cover will decrease slightly from approximately 1,000 feet to 900 feet.

Experience at the SUFCO Mine indicates that the magnitude of subsidence increases with decreasing depth of cover. The abundance of sandstone in the Blackhawk Formation and Castlegate Sandstone in the overburden is also an important factor in subsidence. Subsidence magnitudes of 7 feet or more have been measured over longwall panels that were not situated under the thick sandstone strata; these areas were generally under less than 700 feet of cover. Where the Castlegate Sandstone exists, subsidence over longwall panels is generally about 4 feet to 5 feet, with depths of cover approximately 1,000 feet.

The average measured angle of draw is 15 degrees over continuous miner and longwall mining areas in the SUFCO Mine (Canyon Fuel 1996b). This applies to both the sides and ends of the panels. Angle of draw measurements over continuous miner sections ranged from 10 to 21 degrees.

Overburden Deformation. In longwall mining and in room-and-pillar mining with pillar recovery, nearly full extraction of the coal resource may be accomplished. When these types of mining are conducted, stress is relieved in the immediate strata surrounding the extracted coal. As a result, collapse of the roof and heaving of the floor occurs. As roof material collapses and the floor heaves, the excavation fills with broken material (gob). In response to the collapse of the immediate roof, overlying strata bend and break under their weight until the strata are supported by the broken material and the inherent stiffness of the strata. The deformation of the overlying strata propagates upward, resulting in the surface expression termed "the subsidence basin". In time, compaction of the gob diminishes until the strata overlying the gob stabilizes (reaching equilibrium). Strata deformation (caving and fracturing) can extend upward into the overburden for a distance of 30 to 50 times the mining height (Peng 1986). Assuming 11 feet to 12 feet mining height in the project area, the strata deformation could extend from 360 feet to 600 feet into the overburden. Where the thickness of overburden strata above the mine level is less than about 600 feet, there is a risk that fractures evident at the surface may be continuous to the mine level.

Tension Cracks. Subsidence-induced tension cracks have been noted above most of the subsided areas in the SUFCO Mine (Canyon Fuel 1996b). The tension cracks generally occur at the trough margins and over the gateroads. Lengths vary from a few feet to 500 feet. Most tend to be oriented subparallel to the primary regional joint set (approximately N21°W) and the long axis of the longwall panels (due north). Vertical displacement along the cracks is uncommon. Horizontal displacement varies from hairline up to 6 inches in width.

Twenty-two tension cracks studied by the FS in 1978 over the SUFCO Mine ranged in width from 1/8 inch to 6 inches. Results of the study indicate most cracks self-heal or close from 13 percent to 100 percent of their original width. The following is an excerpt from this report (DeGraff 1979):

...Monitoring stations were installed along twenty-two different cracks widely distributed over the subsiding area. Weekly measurements were taken from mid-June to October. Cracks range in width from 6 inches to 1/8 inch. Preliminary analysis confirms the "self-healing" activity. Several cracks closed to less than 1/16 inch. "Self-healing" rate averages slightly more than 1/16 inch per week of closure. Measured rates ranged from less than 1/32 inch to more than 1/4 inch per week. The average amount of crack closure is 56 percent...

Measured strikes were approximately due north for observed cracks along the gateroads over the SUFCO Mine. Strikes for observed cracks along the barrier pillars ranged from due east to N60°E, or roughly parallel to the strike of the regional secondary joint set (N69°E). Near the Quitcupah Canyon escarpment, strikes over the gateroads were aligned with the regional primary joint set (N21°W), suggesting that, near the escarpments, subsidence induces opening of natural joints rather than the formation of new cracks.

Observed tension cracks were 2.5 inches wide or less at all locations 300 feet or more back from the canyon rim. At two locations over the gateroads, crack thicknesses were approximately 2.5 inches. All other crack apertures were approximately 1 inch or less.

Observations of cracks were made over the longwall panel adjacent to the Project Area in May of 1998. Cracks were observed parallel to the gateroads and to the panel end. Cracks parallel to the gateroads were visible where soil was nonexistent or very thin (say an inch or two thick). In general these cracks ranged in thickness from hairline up to approximately 1.0 inch thick but averaged less than 0.5 inches thick. Cracks parallel to the panel end (north end) were observed crossing the dirt road. These cracks were 1 to 2 inches wide. Cumulatively, the cracks near the panel end totaled 3 or 4 inches total displacement. These observations were in agreement, with respect to location and relative magnitudes, with the analyses results presented in the Final Geology, Topography, and Subsidence Technical Report (Agapito Associates 1998) contained in the FS MLS project file. Notable is the fact that cracks paralleling the longwall face could not be found. This supports experiences that the transient strains are of less magnitude at the ground surface than the permanent strains.

Observations of cracks in ephemeral channels above the SUFCO Mine indicate that exposed fractures induced by mining can heal naturally, especially with the aid of ordinary storm events. Voids rapidly fill and are sealed by sediment and organic material, such as sticks, pine needles, pine cones, pine cone fragments, and elk dung. A survey conducted during a 1997 rainstorm revealed that no ephemeral streams under observation drained noticeably into mining-induced fractures (Goodrich and Agapito 1997). Stock ponds transected by surface cracks generally remained full, with the exception of Rock Pond. Rock Pond, located over the center of a panel, was drained by cracks. Bentonite grouting was used to seal the fractures to attempt to restore water retention; however, attempts thus far have had little success.

3.1.2 Environmental Consequences

Proposed longwall mining in the Project Area will result in some degree of vertical subsidence and horizontal surface strain (i.e. the percentage of extension or compression at the ground surface), both during the course of mining (i.e., transient behavior), and after mining has been completed (i.e., permanent alteration). Environmental consequences from mining-induced subsidence can include lowered surface elevations, tensions cracks, cliff toppling, rock shelter damage, water table fluctuation, alteration of stream flows, and stream gradient changes. The degree of subsidence and environmental consequences of subsidence at specific sites are controlled by both the sequence of mining and the final mining geometry.

Subsidence Evaluation Methodology. Subsidence predictions were made using a numerical model calibrated with baseline subsidence data from the SUFCO Mine. The surface response to mining in the Quitcupah Tract was used to establish modeling parameters. The calibrated version of this model was used to make quantitative predictions of the subsidence expected within the Project Area. The similarities in geology and geometry (depth of cover, face width, gateroad

configuration, mining height) between the area studied in the Quitchupah Tract and the neighboring Project Area justify the use of the back-analyzed parameters for the predictive model.

Some uncertainty exists for predictions made with the model due to geologic and mining geometry variations. Precise estimations of subsidence can only be made for a specific mining geometry. Even moderate changes to that geometry can compromise the accuracy of subsidence predictions. Model predictions are based on the reasonable assumption that potential future longwall mining in the Project Area will be similar to that practiced at the SUFCO Mine.

3.1.2.1 *No Action Alternative*

Under the No Action-No Lease Alternative, no impacts from mining would occur in the Project Area. Mining, and consequently subsidence, would continue to occur in the adjacent Quitchupah Lease. Mining in the adjacent Quitchupah Lease will have no subsidence effect on the Project Area as long as full extraction mining provides a buffer of approximately 270 feet from the boundary. The buffer distance of 270 feet is based on the angle of draw of 15° and the depth of cover of approximately 1,000 feet.

3.1.2.2 *Alternative B*

Alternative B applies to mining in the currently unleased portions of the Project Area (i.e. 1) the Pines Coal Lease Tract, and 2) the 150-acre Lease Modification Area). This alternative excludes impacts to the Box Canyon Permit Amendment Area.

Predicted maximum subsidence is approximately 4 to 5 feet for any mined location in the Project Area, assuming a maximum face width of 1,000 feet and rigid gateroad pillars. When mining occurs at shallow depths of cover out from under the Castlegate Sandstone, vertical subsidence may increase to over 7 feet. Predicted subsidence over the gateroads is approximately 1.5 to 2.0 feet. After subsidence, areas over the gateroads will be approximately 2.4 feet higher than above the longwall panel centerlines. Subsidence in the East Fork of Box Canyon is predicted to be the same as on the plateau. Subsidence is expected to be greater if longwall mining heights exceed 12 feet or if alternative gateroad designs are employed. Surface subsidence is permanent once fully developed, typically within 1 year after mining. Under Alternative B, subsidence can occur under perennial streams and interior escarpments in the East Fork of Box Canyon and under perimeter escarpments in Link and Muddy Creek Canyons.

Predicted vertical subsidence will not be visually discernable anywhere in the Project Area. Surface gradient change will be too gradual for casual observation. However, consequences of the subsidence (e.g., ponding or rockfalls) may be recognizable. Although two to five feet of subsidence are anticipated over the longwall panel areas, the surface expression will be uniform with gentle slopes. Maximum dips from the no subsidence areas at the panel ends to the maximum subsidence areas within the panels will be on the order of 1° (1.7%). Slopes of this order are visibly imperceptible. Longwall subsidence is generally a gentle process that occurs progressively and cannot usually be felt on the surface above the active workings. On the Pines

plateau proper, there will not be a risk to public safety due to subsidence. In escarpment areas, there could be an increased risk to safety during active subsidence of escarpment areas.

In general, impacts from vertical subsidence alone are less damaging to surface features than are horizontal movements. The predicted degree of vertical movement, in itself, should not present serious damage to surface features. The effects of subsidence to streams is discussed in Section 3.3. Horizontal strain is generally responsible for visually observable effects.

Potential exists for room-and-pillar mining at various locations in the Project Area, particularly in the eastern and southern Project Area. First-pass or "full support" mining (where elastic pillars are left behind to support the ground) is not expected to cause measurable subsidence or subsidence-related impacts during the course of mining. This applies to estimated extraction ratios less than 50 percent. Residual subsidence is possible over first-pass mining areas, but would not be expected to occur for several years, decades, or even centuries, after mining. Larger pillar widths and lower extraction ratios tend to delay residual subsidence. Subsidence over first-pass mining is most likely to be a fraction of that produced by equivalent-height longwall mining. The available data are insufficient to allow an accurate prediction of potential residual subsidence or its subsequent impacts.

High-extraction, second-pass room-and-pillar mining (where pillars left during development are subsequently partially mined) often yield extraction ratios between 70 percent and 90 percent. This practice can lead to immediate roof caving similar to that produced by longwall mining and, consequently, presents similar potential for subsidence and cliff damage during or soon after mining. Experience at the SUFCO Mine suggests that most subsidence damage occurs within 1 year after longwall mining.

The potential for damage from *permanent* strain (including cracks, rock spalling in alcoves, and slabbing along cliffs) will be greatest along the sides and starting/terminal ends of the panels where tensile strain is highest.

It is possible for *transient* strain, particularly tensile strain, to permanently damage natural bridges, rock alcoves, and escarpments, in addition to *permanent* strain. The magnitude of transient strain, and, thus the potential for strain-related damage, is likely to be considerably less than that of the permanent strain.

The only perennial stream that would be affected under Alternative B is the East Fork of Box Canyon. Maximum subsidence of the streambed is predicted to be 4 feet to 5 feet. Differential subsidence along the stream course will result in both increases and decreases in the channel gradient. Maximum increase in the stream inclination are predicted to be less than 0.85 percent, or 0.85 feet of drop per 100 feet of horizontal distance. Peak increases in gradient are predicted to be less than 1 percent or 1 foot of loss per 100 feet of horizontal distance.

Cracks in stream channels may temporarily form during the passage of the face, but could later close once the transient tensile strain relaxes. Effects to streams are discussed in Section 3.3. Collapse of unsupported spans during mining is possible even where permanent strains formed after mining do not threaten the stability of such features. Transient strain can be reduced by maintaining a high rate of panel retreat. The faster the retreat rate, the more uniform is the development of subsidence, thus a reduction in the magnitude of transient strain. This can help to protect surface features located toward the centers of longwall panels. Where gateroads cross stream channels, there may be permanent cracking in the stream bottom.

The probability is high that tension cracks will form parallel to and above the panel edges. Because of the variability in the geologic conditions, cracks central to the longwall panels of any orientation are a distinct possibility. Based on mapping thus far, surface cracks are expected to range in length from tens of feet up to 500 feet. Tensile cracks are not generally predicted to extend beyond 270 feet from the edge of a panel. Tension cracks have the potential to drain ponds, divert stream flows underground, destabilize escarpments, and expose plant roots.

Escarpments along Upper Box, the East Fork of Box, Muddy, and Link Canyons could be subjected to potentially destabilizing ground movements. The uncertainty regarding the magnitude of the transient strains obscures predictions regarding the extent of possible escarpment damage.

Nevertheless, for Upper Box and the East Fork of Box Canyons factors including shallow canyon depths, cliff aspect, exposure, and face concavity are expected to mitigate any destabilization. Mining-induced cliff instability is expected to be non-existent to moderate. Rock overhang structures in these canyons may fail due to subsidence ground movements. The probability for failure is dependent on the individual structural integrity of the overhang and geometry of nearby mining. At greatest risk to falling are the blocks on the leading outer edges of the rock overhangs. These outer blocks are the least confined and the most weathered.

Perimeter escarpments closer than approximately 270 feet to a longwall panel edge are at risk for some level of subsidence-induced instability. This assumes an average mining depth below escarpments of between 900 feet and 1,000 feet. The highest potential for cliff toppling failure exists in Link Canyon, Muddy Creek Canyon, and along Wileys Fork of Muddy Creek Canyon because of: 1) the large cliff height (up to 300 feet within the probable subsidence influence zone), 2) little concavity in the cliff face, and 3) the problematic orientation of probable tension cracks. Potential impacts include block toppling from the steeper cliffs and rock falling hazards posed to people, wildlife, and vegetation. Falling blocks can scour vegetation from talus slopes below collapsing escarpments. Failures are generally not continuous along escarpments for long distances (> 100 feet) and usually occur at isolated locations, particularly at promontories.

The low maximum angle of tilt predicted (about 1°) is unlikely to destabilize balanced rocks. Nevertheless, limited potential does exist for subsidence-induced collapse of balanced rocks

already on the verge of natural collapse. Such potential occurrences are expected to be isolated and infrequent.

The potential for failure of an escarpment due to longwall mining in a given area depends on many factors as discussed in the Geology portion of Section 3.1. Qualitatively speaking, the potential for escarpment failure in Upper Box and East Fork of Box Canyons (interior escarpments) is low (using a scale of low, medium, high). Isolated blocks may slide or fall but failure of the escarpment is unlikely. Where the East Fork of Box Canyon is quite deep, near its confluence with Upper Box, there is a medium potential for escarpment failure. The same is true for Link Canyon, Muddy Creek Canyon, and along Wileys Fork of Muddy Creek. A failure, however, may only account for a few percent of the total linear feet of escarpment.

A portion of the perimeter escarpments may be affected due to mining in the Lease Modification Area. The potential is predicted to be low, however, since the width of bleeder entries along the margin of the Lease Modification Area would probably provide a sufficient buffer to mitigate escarpment failures.

Mining in the vicinity of the confluence of the main limb of Box and East Fork of Box Canyons could result in greater subsidence than predicted over other foreseeable mining areas. This is due to the shallower depth of cover near the canyons. Roof caving above longwall panels typically attenuates underground before reaching the surface, allowing overlying strata to bend gently without substantial disturbance, as typical over most of the study area. Cover in the vicinity of Box and East Fork of Box Canyons may be as little as 400 feet, as illustrated in Figure 3-2. Under such shallow cover, it is possible for caving to propagate to surface, or nearer the surface, with the potential for greater than normal localized subsidence (i.e., more than 5 feet). The magnitude of such localized subsidence is generally unpredictable, but cannot exceed the mining height. Significant localized ground fracturing is possible, leading to heightened potential for drainage of perennial streams in the canyons. Impacts to surface waters are discussed in Section 3.3.

3.1.2.3 *Alternative C*

Surface subsidence would not be allowed that could either: 1) cause escarpment failure, or 2) result in damage or alteration to the flow of perennial streams. This excludes longwall mining beneath Box Canyon, the East Fork of Box Canyon, and near the escarpments in Link, Muddy Creek, and Wileys Fork of Muddy Creek Canyons. The perennial streams in Box Canyon and East Fork of Box Canyon would be protected from mining and would incur no disturbance. Impacts to the Pines Plateau surface not excluded from mining are the same as for Alternative B. Protection of noncoal resources would be provided by a buffer of approximately 270 feet from the boundary of full extraction mining to the resource. The buffer distance of 270 feet is based on the angle of draw of 15° and the depth of cover of approximately 1,000 feet. Subsidence monitoring would be required under SCLS #7.

First-pass room-and-pillar mining is possible in the Lease Modification Area and under Box Canyon (Permit Amendment Area). In order to access the Lease Modification Area, full support mining may be applied under Box Canyon to prevent subsidence, but allow for access to the coal in the Lease Modification Area. Unlike second-pass mining, the remnant pillars left by first-pass mining (< 50 percent extraction ratio) are expected to remain stable indefinitely in the RFDS. Subsidence over first-pass continuous miner panels would be similar to that expected over mains and bleeders (i.e. negligible to undetectable). Consequently, subsidence-related impacts could also be avoided including escarpment failure, tension cracking, and perennial stream gradient changes.

It is also possible that otherwise long panels could be shortened and separated into two or more panels along their length by leaving mid-panel barrier pillars. Mid-panel barrier pillars could be used to prevent subsidence beneath sensitive sites, e.g. perennial streams, while allowing the continuation of the panel beyond the barrier. With each mid-panel barrier pillar, one additional longwall move is required, resulting in lower mining efficiency and higher production costs.

3.1.2.4 *Alternative D*

Subsidence consequences for this alternative are the same as for Alternative B, except for the addition of subsidence impacts in the Permit Amendment Area. Additional impacts associated with this alternative are subsidence of: 1) the Box Canyon perennial stream, 2) Box Canyon rock overhangs sites, and 3) escarpments along Box Canyon. Impacts specific to Box Canyon are discussed. Other escarpment failure would be the same as under Alternative B.

Vertical subsidence of the perennial stream in Box Canyon from the RFDS is predicted to reduce the natural gradient by almost 1 percent (or 1 foot of elevation per 100 feet of length) in some locations. After mining, model predictions (Agapito Associates 1998) indicate this gradient could be reduced to 0.0 (nearly flat) over a distance of a few hundred feet in the main limb of Box Canyon. Some potential for shallow ponding exists. The minimum average perennial stream gradient in the eastern limb of Box Canyon is not expected to fall below 2.8 feet per 100 feet (or 2.8 percent) after mining from a pre-mining gradient of 3.6 feet per 100 feet. In some locations the gradient is expected to increase by as much as 1 percent over a few hundred feet depending upon the mining geometry.

The risk of crack formation in the channel bedrock in Box and East Fork of Box Canyons is the same as discussed under Alternative B.

Given the small angles of tilt expected in Box Canyon due to the RFDS subsidence few, if any, rockfalls are anticipated. Angles of tilt are expected to be less than 1 degrees. Large mass movements can occur from escarpments in canyons like Quitcupah, but are far less likely in Box Canyon. Exposure, cliff height, aspect, and concavity of the escarpments in Box Canyon are favorable toward mitigating subsidence-induced damage. Falls of balanced rocks are considered unlikely but nevertheless possible in Box Canyon. Block falls, if they occur in Box Canyon, pose

a hazard to people, wildlife, and vegetation. Damage to cultural resource sites in Box Canyon could result from escarpment failure.

The rock overhangs sites located at Box Canyon are not likely to be subjected to the large lateral and vertical movements that occurred in the Castlegate Sandstone escarpment in Quitchupah Canyon at the experimental subsidence area and at Twin Bridges. Lateral and vertical movements will be much less at Box Canyon than at Quitchupah Canyon because of differences in the two canyons. At Quitchupah Canyon, exposure of weak foundation strata underlying the Castlegate Sandstone and natural jointing have contributed to destabilizing the escarpments.

Damage potential for the rock shelters is the same as described for rock shelters under Alternative B. Uncertainty exists as to the likelihood of these risks, also discussed under Alternative B. Subsidence monitoring will be required that will determine impacts and provide the opportunity to mitigate and increase the understanding of the subsidence impacts.

The effects related to subsiding the perennial streams and escarpments are the same as for Alternative B.

3.1.3 Mitigation and Monitoring

Subsidence from the proposed RFDS would affect much of the land within the Project Area depending upon the various NEPA alternatives and mining geometry. For all alternatives except No Action Alternative, the primary impact of mining will be differential subsidence of the Pines Plateau. For the vast majority of the Project Area, the changes in elevation will cause no visually perceptible impact, nor disturb ecosystems. No special subsidence monitoring is proposed other than as routinely required by the lease stipulations.

Perceivable impacts will be localized to the rock shelters, escarpments, stock ponds, and streams in the Box Canyon and East Fork of Box Canyon and other escarpments along Muddy Creek, Wileys Fork of Muddy Creek, and Link Canyons. Potential impacts can be mitigated by two approaches: 1) complete prevention by modifying the proposed RFDS to isolate sensitive areas from subsidence effects (as per Alternative C); or 2) proceeding with the proposed RFDS, but undertaking measures to prepare for, monitor, and/or repair impacts from subsidence (as provided by Alternatives C and D).

The **first mitigation alternative** requires protecting sensitive sites by establishing buffer corridors where full-extraction mining is excluded, corresponding with mining Alternative C. Consequently, subsidence impacts to sensitive surface features will be insignificant. Buffers surrounding these sites will require either re-orienting the proposed longwall panels, reducing panel lengths, or dividing single panels with barrier pillars into two or more panels. These measures will impact the proposed mine plan by diminishing operational efficiency, reducing coal recovery, and lessening the economic value of the resource. Buffers can provide complete protection of sensitive sites, but require selective sterilization of the coal resource.

The **second mitigation alternative** allows mining to progress under sensitive areas (as provided in Alternative D) and for subsidence, and its subsequent impacts, to develop as previously described.

Public safety may be a concern where escarpment failure and potential blocks falls may occur. It is recommended that these areas be signed, warning the public of possible danger.

3.1.4 Cumulative Effects

Because the effects of subsidence are geographically limited by the angle of draw and depth of cover, mining impacts from adjacent tracts will not affect the Pines Tract Project Area. Based on the past, present and future actions no cumulative impacts are anticipated. This applies to all four alternatives.

3.1.5 Residual Adverse Impacts

Residual adverse impacts include: subsidence troughs, open cracks, collapse of rock overhang cultural resources, escarpment failures and gradient changes to the streams.

3.1.6 Irreversible/Irretrievable Commitment of Resources

Irreversible/irretrievable commitments of resources include: subsidence troughs, open cracks, collapse of rock overhang cultural resources, escarpment failures and gradient changes to the streams.

3.1.7 Short Term Uses vs. Long Term Productivity

The potential draining of stock ponds and the potential loss of stream flow in the perennial streams are short term uses. However, these resources will heal naturally or through reclamation efforts and not affect long-term productivity.

The potential failure of an escarpment could damage underlying vegetation which poses a short term impact. This would not reduce the long term productivity.

3.2 GROUNDWATER

3.2.1 Affected Environment

The analysis area for groundwater resources encompasses the Pines Tract Project Area, Muddy Creek, Link Canyon, and Wileys Fork. Because mining can impact groundwater resources beyond tract boundaries, this analysis discusses potential impacts to groundwater resources within an area extending from Box Canyon eastward to Wileys Fork and from Muddy Canyon southward to Link Canyon. These topographic features are shown on Figure 3-4.

This environmental analysis is based on the following assumptions:

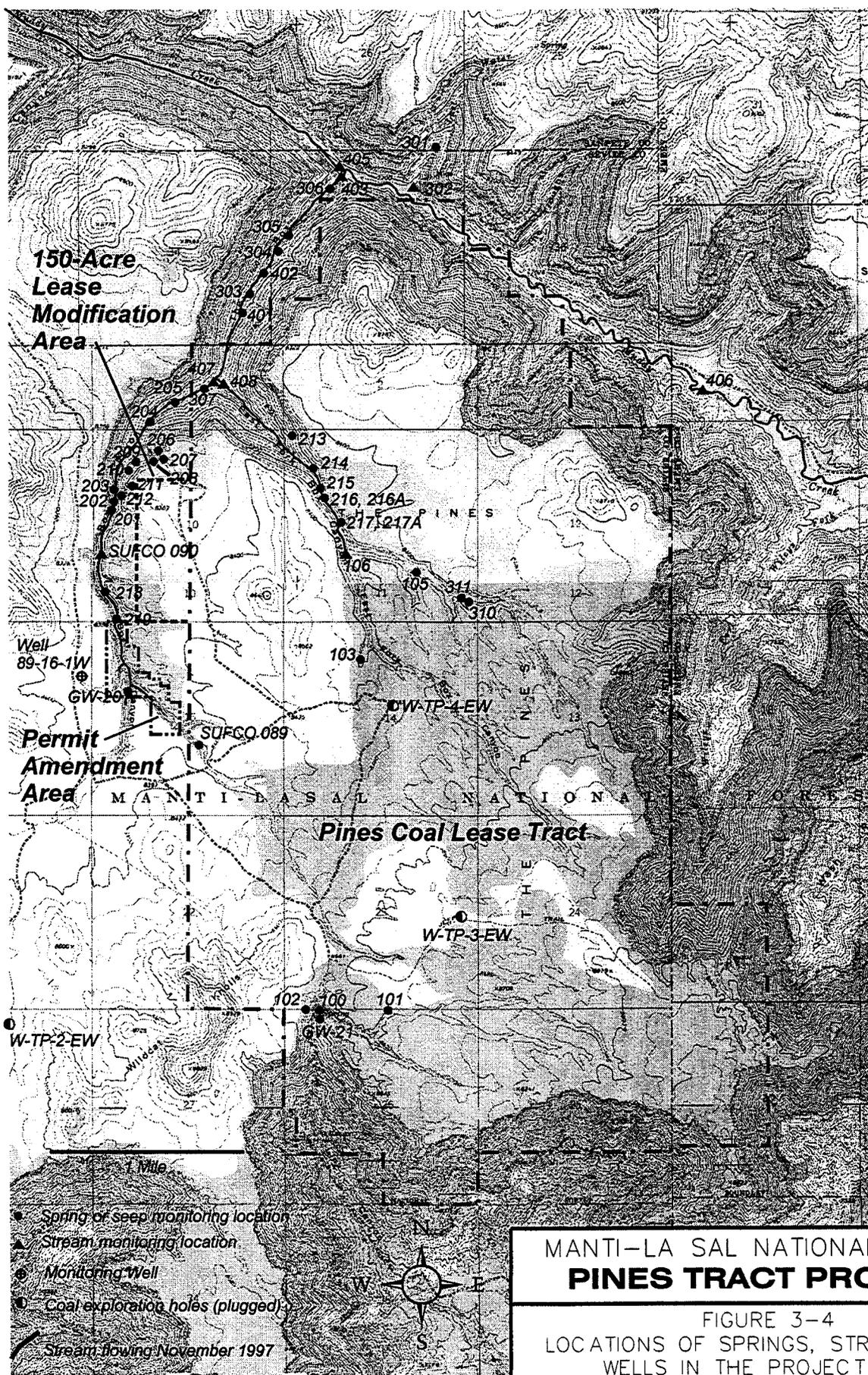
1. The hydrogeology of the Pines Tract Project Area and Lease Modification Area is similar to that in the adjacent Quitchupah Lease. This assumption is reasonable because the Project Area and the Quitchupah Lease share common and continuous bedrock lithologies, geologic structure, geomorphology, and climate.
2. The effects of coal mining at the existing SUFCO Mine on groundwater systems can be extrapolated into the Pines Tract Project Area. The overburden thickness, proposed mining geometries, and proposed extraction methods in the Project Area are similar to those at the adjacent SUFCO Mine.

In addition to these assumptions, this analysis of the potential environmental impacts incorporates:

1. Characterizations of the hydrogeology of the Pines Coal Lease Tract, Lease Modification Area, and Permit Amendment Area,
2. Comparison of baseline discharge, solute, and isotopic data collected from the Pines Tract Project Area to similar data collected in adjacent areas, and
3. Descriptions of mining-related impacts in other portions of the Quitchupah Lease.

Previous Investigations and Existing Data

The United States Geological Survey (USGS), in cooperation with the BLM (Thiros and Cordy 1991), described the hydrology and potential effects of mining in the Pines Coal Lease Tract. Mayo and Associates (1993) evaluated factors contributing to the total dissolved solids (TDS) of SUFCO's Mine discharge water. Mayo and Associates (1997a) described surface water and groundwater systems and mining-related hydrologic impacts in the adjacent Quitchupah Lease. Mayo and Associates (1997b) evaluated the probable hydrologic impacts of longwall mining to the hydrologic balance of Box Canyon.



• others blackback
 Gas Hycle SF
 Seasonal
 Variation
 Fig 3-5

- Spring or seep monitoring location
- ▲ Stream monitoring location
- Monitoring Well
- Coal exploration holes (plugged)
- Stream flowing November 1997

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FIGURE 3-4
 LOCATIONS OF SPRINGS, STREAMS, AND
 WELLS IN THE PROJECT AREA

SCALE	NTS	DATE DRAWN	4/21/98
		LAST REVISION	7/28/98

Canyon Fuel performed a spring and seep inventory and baseline hydrologic monitoring of the Pines Coal Lease Tract in 1997. Data from this inventory are reported in the 1997 Pines Tract Data Adequacy (Canyon Fuel 1997). Table 3.1 is an index of spring and stream monitoring locations in the Pines Coal Lease Tract and adjacent areas.

Geologic Setting

Five bedrock formations crop out in the Project Area; in descending order (from the surface to depth) these units are the Price River Formation, the Castlegate Sandstone, the coal-bearing Blackhawk Formation, the Star Point Sandstone, and the Masuk Member of the Mancos Shale. Each is described in Section 3.1 and the Final Geology, Topography, and Subsidence Technical Report (Agapito Associates 1998). All formations were deposited along the margin of a shallow sea; regressions and transgressions of this sea resulted in a heterogeneous sequence of rock types that are both horizontally and vertically discontinuous. The heterogeneity dictates the water-bearing and water-transmitting properties of these rocks, as discussed below.

The Price River Formation forms low-lying hills on the plateau. In the project area, the Price River Formation has been partially to wholly eroded away. Thiros and Cordy (1991) report that this formation is present in only about 25 percent of the Pines Tract and is found mostly in the northern portion of the Pines Tract. The Price River Formation consists of sandstone interbedded with shale. Mudstone drapes deposited during low-flow periods separate fluvial sandstones from each other both horizontally and vertically. Thus, while the fluvial sandstones in the Price River Formation are capable of transmitting water, water is not transmitted any significant vertical or horizontal distance because of these mudstone drapes.

The Castlegate Sandstone is predominately massively bedded, coarse-grained sandstone with some interbeds of shale, siltstone, and conglomerate. Mudstone layers and cement restrict groundwater movement in the Castlegate Sandstone. Near cliff exposures and in stream bottoms, the Castlegate Sandstone becomes friable due to the dissolution of the carbonate cement thus becoming more capable of supporting active groundwater systems.

The Blackhawk Formation is an interbedded sequence containing approximately 60 percent to 65 percent sandstone interbedded with siltstone, mudstone, shale, and coal. The sandstone units are isolated from each other both laterally and vertically by mudstones and shales, which isolate the permeable units and hamper groundwater movement. It has been determined in other areas of the Wasatch Plateau that shale in the Blackhawk Formation contains swelling clays that when wetted swell to anneal any natural or induced fractures.

The upper Star Point Sandstone consists massive sandstones; the lower Star Point Sandstone is an upward prograding sequence of thin sandstones, siltstones, and shales that intertongue with the underlying Masuk Member of the Mancos Shale. The Masuk represents a thick sequence of impermeable rock has poor water-transmitting potential.

Table 3.1 Index of Springs and Creeks in the Pines Tract Project Area

Site	Location	Geology
Creeks		
Pines 106	Upper East Box Canyon	
Pines 107	Muddy Creek at Emery Diversion	
Pines 302	Last Water Canyon creek	
Pines 403	Lower Box Canyon Creek	
Pines 405	Muddy Creek at Box Canyon confluence	
Pines 406	Muddy Creek at east Pines Coal Lease Tract boundary	
Pines 407	Box Canyon Creek at confluence with East Fork	
Pines 408	East Fork Box Canyon at confluence with Box Canyon Creek	
SUFCO 090	Box Canyon Creek at northern Quitcupah Lease boundary	
Springs		
Pines 100	Top of Link Canyon	Castlegate Sandstone
Pines 101	Top of Link Canyon	Castlegate Sandstone
Pines 102	Top of Link Canyon	Castlegate Sandstone
Pines 103	Joes Mill Spring, East Fork Box Canyon	Castlegate Sandstone
Pines 105	North Water Spring, East Fork Box Canyon	Castlegate Sandstone
Pines 201	Middle Box Canyon	Castlegate Sandstone
Pines 202	Middle Box Canyon	Blackhawk Formation
Pines 203	Middle Box Canyon	Blackhawk Formation
Pines 204	Middle Box Canyon	Blackhawk Formation
Pines 205	Middle Box Canyon	Blackhawk Formation
Pines 206	Middle Box Canyon	Blackhawk Formation
Pines 207	Middle Box Canyon	Blackhawk Formation
Pines 208	Middle Box Canyon	Blackhawk Formation
Pines 209	Middle Box Canyon	Blackhawk Formation
Pines 210	Middle Box Canyon	Blackhawk Formation

Table 3.1 Index of Springs and Creeks in the Pines Tract Project Area (cont).

Site	Location	Geology
Pines 211	Middle Box Canyon	Blackhawk Formation
Pines 211A	Middle Box Canyon	Blackhawk Formation
Pines 212	Middle Box Canyon	Blackhawk Formation
Pines 213	East Fork Box Canyon	Blackhawk Formation
Pines 214	East Fork Box Canyon	Blackhawk Formation
Pines 215	East Fork Box Canyon	Blackhawk Formation
Pines 216	East Fork Box Canyon	Blackhawk Formation
Pines 216A	East Fork Box Canyon	Blackhawk Formation
Pines 217	East Fork Box Canyon	Castlegate Sandstone
Pines 217A	East Fork Box Canyon	Castlegate Sandstone
Pines 218	Upper Box Canyon	Castlegate Sandstone
Pines 219	Upper Box Canyon	Castlegate Sandstone
Pines 301	Last Water Canyon	Blackhawk Formation
Pines 303	Lower Box Canyon	Blackhawk Formation
Pines 304	Lower Box Canyon	Blackhawk Formation
Pines 305	Lower Box Canyon	Blackhawk Formation
Pines 306	Lower Box Canyon	Star Point Sandstone
Pines 307	Lower Box Canyon	Blackhawk Formation
Pines 310	East Fork Box Canyon	Castlegate Sandstone
Pines 311	East Fork Box Canyon	Castlegate Sandstone
Pines 401	Lower Box Canyon	Blackhawk Formation
Pines 402	Lower Box Canyon	Blackhawk Formation
SUFCO 089	Head of Box Canyon (pond with stage)	Castlegate Sandstone
GW-20	Box Canyon	Castlegate Sandstone
GW-21	Link Canyon spring	Castlegate Sandstone

Bedrock formations in the project area dip 2 degrees to the northwest. No major faults have been identified in the project area. However, natural bedrock fractures are common.

Data Analysis

Solute Chemistry. Groundwaters that discharge from the Castlegate Sandstone have relatively low TDS, calcium (Ca^{2+}), magnesium (Mg^{2+}), and bicarbonate (HCO_3^-) concentrations and are undersaturated with respect to carbonate minerals (Mayo and Associates 1998; Thiros and Cordy 1991; Mayo and Associates 1997a). The low TDS is attributed to the general lack of soluble minerals (e.g., halite and gypsum) in the Castlegate Sandstone. The low concentrations of carbonate mineral constituents and the undersaturation of Castlegate Sandstone groundwaters with respect to carbonate minerals is consistent with recharge occurring on the relatively barren rock surfaces of exposed Castlegate Sandstone where soil zone carbon dioxide (CO_2) is low.

Six years of solute data are available (Mayo and Associates 1997a) for spring SUFCO 089 at the head of the Upper East Fork (Figure 3-4) and Box Canyon Creek at site SUFCO 090 (Figure 3-4). The baseflow TDS concentration of spring 089 is 66 mg/l and Box Canyon Creek at 090 is 91 mg/l. The baseflow solute composition of spring 090 is especially significant because it represents the weighted average solute composition of all springs and seeps in the canyon above this point. One solute analysis is reported (Thiros and Cordy 1991) for spring GW-20 in the Upper Middle Fork (Figure 3-4) which indicates that the TDS of this spring was 142 mg/l in September 1986. These data can be directly compared with geochemical data from Price River Formation springs, which have considerably higher TDS (mean = 575 mg/l), Ca^{2+} , Mg^{2+} , and HCO_3^- concentrations and are oversaturated with respect to carbonate minerals (Thiros and Cordy 1991). This comparison demonstrates that water in the Castlegate Sandstone groundwater systems has not been in contact with the Price River Formation. If these groundwaters had recharged through the Price River Formation, the TDS and carbonate mineral dissolution products in the Castlegate Sandstone groundwaters would be considerably higher. This is significant because the Price River Formation forms the low-lying hills within 100 feet to 1,000 feet of the canyon rims, implying that the recharge area for Castlegate Sandstone groundwater systems is the plateau on the perimeter of the canyon rims.

The mean TDS concentration of Blackhawk Formation groundwaters is 258 mg/l. This concentration is greater than that of Castlegate Sandstone groundwaters but still significantly less than that of Price River Formation groundwaters. For this analysis, the geochemical evolution of Blackhawk Formation groundwater was modeled using the computer code NETPATH (Plummer et al., 1991). Using the mean solute and $\delta^{13}\text{C}$ compositions of Castlegate Sandstone groundwaters as the initial water, it is not possible to model a reasonable geochemical evolution from Castlegate Sandstone waters to Blackhawk Formation waters, suggesting different recharge mechanisms for these two waters.

Isotopic Chemistry. The stable isotopic composition of carbon in groundwater is useful for differentiating the recharge locations of groundwater systems in the Project Area. Most

groundwater acquires half of its carbon from soil zone gas and half from the dissolution of carbonate minerals in the soil zone or bedrock. The $\delta^{13}\text{C}$ of marine carbonate minerals is about 0‰ and the $\delta^{13}\text{C}$ of soil zone CO_2 gas is -18 to -27‰. Consequently, most groundwaters have a $\delta^{13}\text{C}$ of about -9 to -14‰. Soil gas $\delta^{13}\text{C}$ compositions are dictated in large measure by type of vegetation and climatic conditions in the recharge area.

In the Project Area, groundwaters that discharge from the Castlegate Sandstone have a mean $\delta^{13}\text{C}$ content of -14.0‰ while groundwaters that discharge from the Blackhawk Formation have a mean $\delta^{13}\text{C}$ content of -10.0‰. Using a two-tailed t-test, these populations are statistically different at the 99 percent confidence level. Because the $\delta^{13}\text{C}$ content of a groundwater is essentially set during flow through the soil zone, the large difference in the $\delta^{13}\text{C}$ contents suggests that the recharge locations for groundwaters in the Castlegate Sandstone are different than the recharge locations of groundwaters in the Blackhawk Formation, or that the groundwaters recharged under different climatic conditions.

Two unstable isotopes, tritium (^3H) and carbon-14 (^{14}C), have been used to evaluate mean residence times (ages) of groundwaters in the Project Area and the SUFCO Mine area. Tritium is a qualitative tool indicating if groundwater has a component of water that recharged since about 1954. Groundwater that recharged prior to about 1954 will contain essentially no tritium. Carbon-14 provides information regarding the number of years that have elapsed since the groundwater became isolated from soil zone gases and near-surface waters. Like tritium, ^{14}C can indicate if groundwater has a component that recharged since the 1950s. Groundwaters with ^{14}C contents greater than about 50 percent modern carbon usually contain anthropogenic (human-induced) carbon contributed by atmospheric nuclear weapons testing. It is not uncommon for groundwater issuing from a spring or occurring in a well to be a mixture of old (i.e., containing no tritium) and younger groundwaters.

Based on comparison of the ^{14}C and tritium compositions (Mayo and Associates 1998) in SUFCO Mine groundwaters with near-surface groundwaters, Mayo and Associates (1997a; 1997b) determined that a hydrologic disconnect exists between near-surface groundwater systems and groundwater systems encountered within the SUFCO Mine. Groundwaters discharging from within the mine have mean groundwater residence times of 7,000 years to 20,000 years and contain no tritium, while near-surface groundwaters have modern ^{14}C and abundant tritium contents. The cause of this disconnect is attributed to shale and mudstone in the Blackhawk Formation that hinder the downward migration of water. This conclusion is consistent with the unsaturated horizons encountered in exploration drill holes at the SUFCO Mine (discussed below).

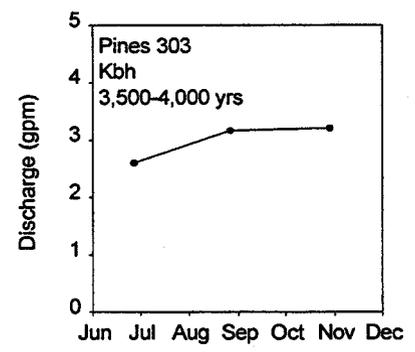
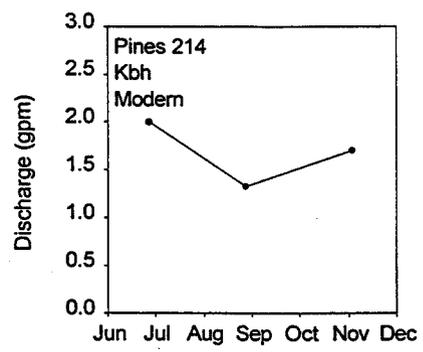
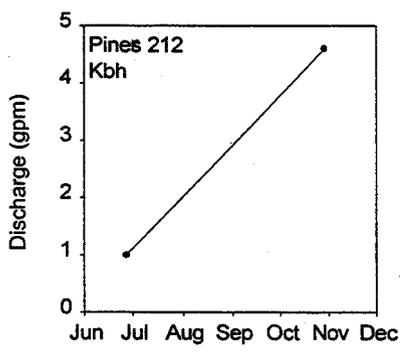
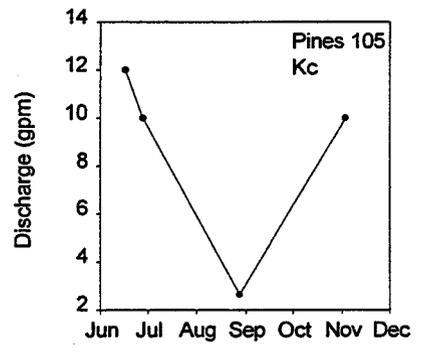
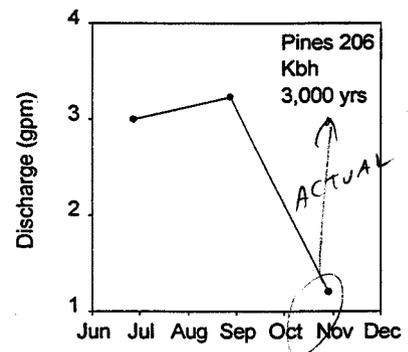
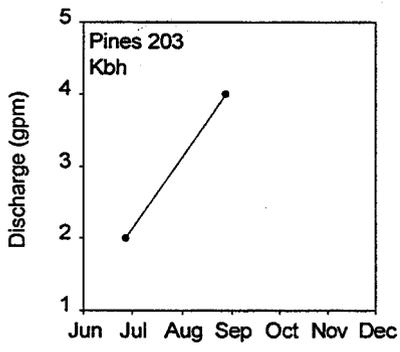
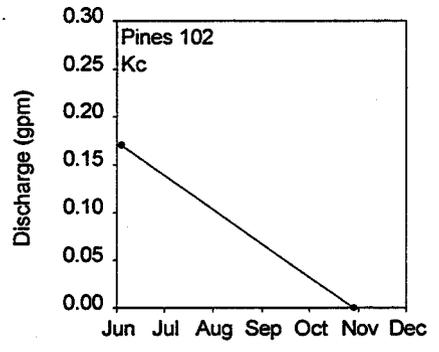
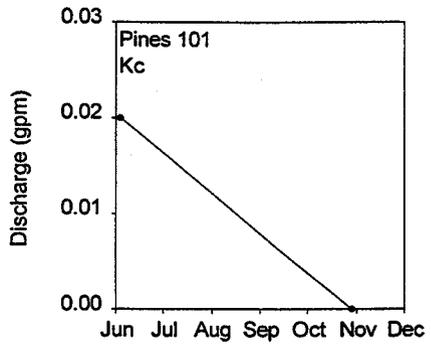
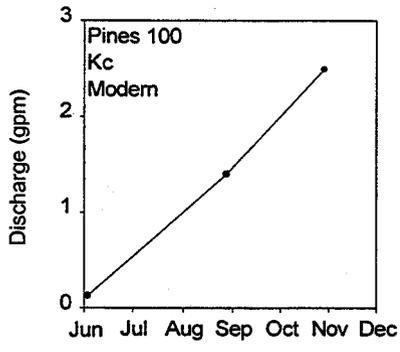
Carbon-14 and tritium data were collected from sites in the Project Area in conjunction with baseline monitoring and as part of previous investigations (Mayo and Associates 1997a). Data are available from nine springs and two creek locations (Mayo and Associates 1998). As indicated by abundant tritium and anthropogenic ^{14}C contents, groundwaters that discharge from the Castlegate Sandstone are modern (meaning that water entered into the groundwater system within

about the last 50 years). Three of the five Blackhawk Formation springs that were sampled for unstable isotopic contents contain only small amounts of tritium (0.08-0.74 TU) and have radiocarbon ages of 500 years to 4,000 years. The remaining two Blackhawk Formation springs have modern isotopic contents. That groundwaters discharging from the Blackhawk Formation in Box Canyon have disparate groundwater ages suggests that the springs discharge from discrete groundwater systems that have varying flow path lengths due to recharge occurring at different locations along the canyon walls and plateau escarpment. This conclusion is discussed further in a subsequent section.

Groundwater Discharge Rates. The response of spring discharges to seasonal and year-to-year climatic changes provides qualitative information about groundwater travel times and/or the volume of water in storage in a groundwater system (travel times are a function of flow path length, gradient, and the hydraulic conductivities of materials supporting the groundwater system.) Fluctuations in spring discharge rates that closely track seasonal and year-to-year climate fluctuations are indicative of groundwater systems that have short travel times and small storage volumes. Discharge rates that tend to be more constant over time are indicative of groundwater systems that have longer travel times and/or have larger quantities of water in storage (i.e., discharge is buffered).

Discharge rates from springs in the Project Area are reported by Mayo and Associates (1998). Spring discharge records that have been quantified (i.e., do not use the "less than" notation) are plotted in Figure 3-5. These graphs indicate that Castlegate Sandstone springs and some Blackhawk Formation springs are highly dependent on recharge events. Springs Pines 101 and Pines 102 completely dried up by October 1997. Discharge from other springs (Pines 100, Pines 203, and Pines 212) increase during the course of the summer. This increase is not surprising because the Project Area experienced a number of particularly heavy thunderstorms during the summer and fall of 1997, and early snows were melting off when the October and November data were collected.

Blackhawk Formation springs Pines 214 and Pines 303 show a fairly constant discharge rate. Pines 214 contains abundant tritium and anthropogenic ^{14}C (Mayo and Associates 1998) and thus likely discharges from a buffered groundwater system. Pines 303 has a radiocarbon age of 3,500 years to 4,000 years (Mayo and Associates 1998), suggesting a long travel time. Pines 206 has a radiocarbon age of 3,000 years. However, the discharge from this spring decreases by more than half between August and October 1997. Such a fluctuation in discharge is not consistent with the radiocarbon age and is problematic. The tritium content (0.52 to 0.69 TU) of groundwater discharging from this spring indicates some mixing of older water with post-1954 recharge. However, the low tritium content suggests that groundwater discharging from this spring has only a small component of modern water, the influence of which is inadequate to account for discharge fluctuations.



MANTI-LA SAL NATIONAL FOREST
PINES TRACT PROJECT

FIGURE 3-5
 HYDROGRAPHS OF SPRINGS IN THE
 PROJECT AREA

SCALE	NTS	DATE DRAWN	4/21/98	LAST REVISION	7/28/98
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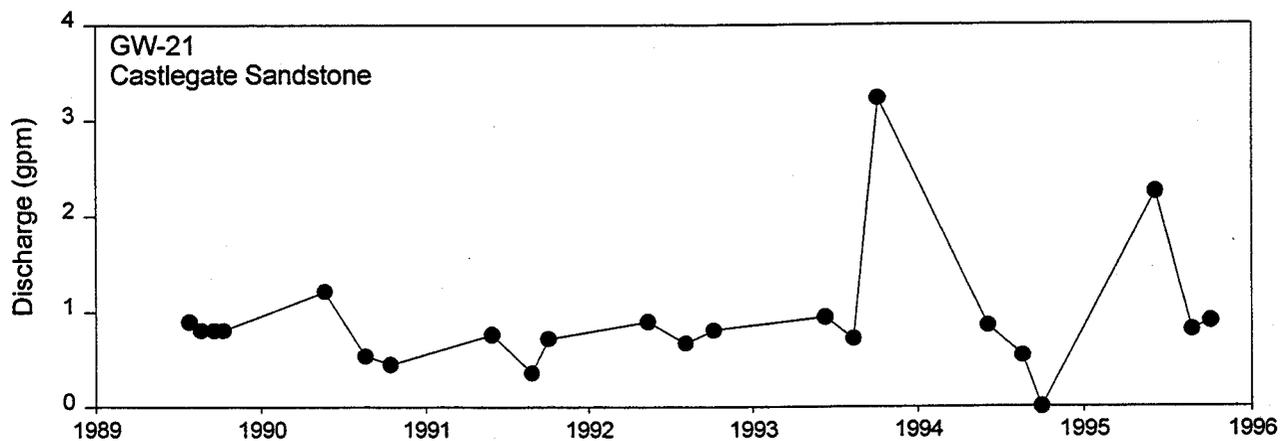
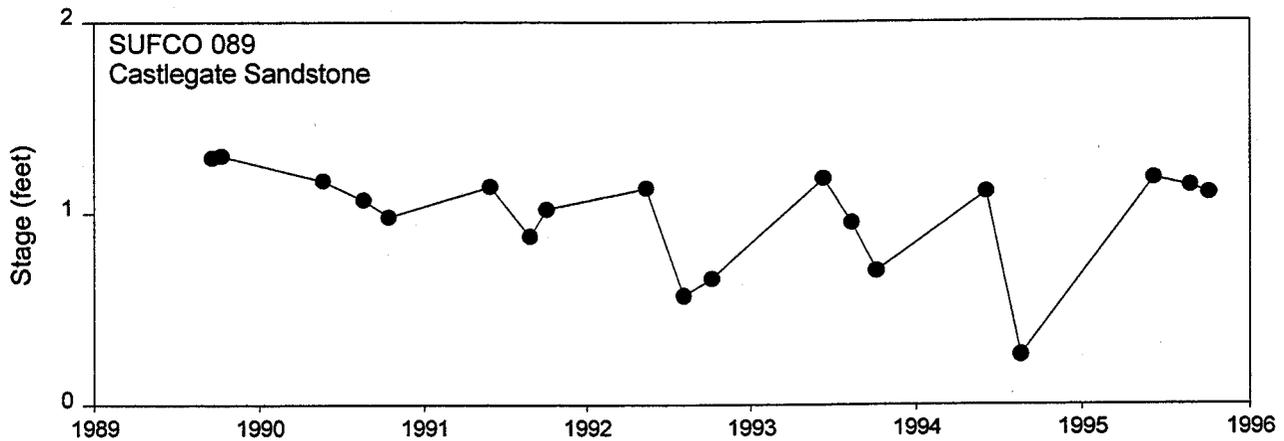
A longer discharge history is available (Mayo and Associates 1997a) for two Castlegate Formation springs, 089 and GW-21, in the Project Area. Discharge hydrographs of these springs are plotted on Figure 3-6. Canyon Fuel has monitored these springs since 1989 as part of their quarterly operational monitoring. These discharge hydrographs indicate that these systems are highly dependent on recharge events. Spring GW-21 has modern isotopic contents (Mayo and Associates 1998).

Monitoring wells and coal exploration holes. A limited number of monitoring wells and coal exploration holes in and near the Project Area provide valuable information about groundwater occurrence in the rocks overlying the mining horizon.

Groundwater monitoring well 89-16-1W is located (Figure 3-4) approximately 1,000 feet west of the rim of upper Box Canyon and is screened from 54 to 160 feet below ground surface. This well has been dry over the period of record (1990 to present). The absence of water in well 89-16-1W indicates that in the vicinity of upper Box Canyon, groundwater systems in the Castlegate Sandstone do not occur at depths greater than 50 feet.

Monitoring well 89-20-2W is located about 1.5 miles southwest of upper Box Canyon and is screened from 67 to 170 feet below ground surface. The water level is about 150 feet below the ground surface. Mayo and Associates (1997a) note that hydrograph data for this well show that, except for an unexplained initial drop, the water level in this well has remained constant despite a period of drought (1988-1993) and several extremely wet years (1993 and 1995). That the water level in this well does not respond to seasonal or year-to-year precipitation changes indicates that the Castlegate Sandstone groundwater system in this area is not in good hydraulic communication with the surface.

Two coal exploration holes (W-TP-4-EW, and W-TP-3-EW) were drilled by the USGS in the Pines Coal Lease Tract in 1976 (Blanchard et al., 1977). Another coal exploration hole (W-TP-2-EW) was drilled 1 mile west of the Pines Coal Lease Tract. The locations of these wells are indicated on Figure 3-4. Exploration hole W-TP-4-EW is located within one-half mile of East Fork Box Canyon. Geophysical logs from the hole indicated that fluid was present at 82 feet below ground surface in the Castlegate Sandstone. In W-TP-3-EW, which is located more than a mile from East Fork Box Canyon and the plateau escarpment, fluid was not present in the Castlegate Sandstone, but was encountered at a depth of 680 feet below the land surface in the Blackhawk Formation. Exploration hole W-TP-2-EW first encountered in the Blackhawk Formation at a depth of 519 feet below ground surface.



*SUFCO 089 is a spring which forms a pond at the discharge location. The depth of water in this pond is measured as a surrogate for spring discharge.

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PINES TRACT PROJECT

FIGURE 3-6
 HYDROGRAPHS OF SPRINGS IN
 THE PROJECT AREA

SCALE	NTS	DATE DRAWN	4/21/98	LAST REVISION	7/28/98
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That groundwater occurs in the Castlegate Sandstone in some holes and not in others indicates that the Castlegate Sandstone does not support an extensive groundwater system, but rather the occurrence of groundwater in the Castlegate Sandstone is localized. That water is first encountered in the rocks overlying the Project Area at depths of 82 to 680 feet, and that seasonal and climatic water level fluctuations are not seen in water levels, suggests that water is not being actively transmitted downward by these rocks.

Groundwater Systems

The notion of a groundwater system is useful to discuss the dynamics of groundwater recharge, flow, and discharge in areas such as the Project Area. In areas such as these, groundwater commonly occurs in horizons that have limited lateral extent. Aquifers, in the traditional sense, do not exist. (An aquifer is often thought of as a geologic unit that can store and transmit water at rates fast enough to supply reasonable amounts to wells). A groundwater system may be thought of as groundwater that: 1) flows through one or more rock units or structures that have similar hydraulic characteristics, and 2) has similar recharge mechanisms, flow patterns, and discharge mechanisms. This definition does not imply or require that groundwater in a particular groundwater system has hydraulic continuity with all other groundwater in that system.

Stratigraphy is a useful framework within which to discuss groundwater occurrence in the Project Area. No springs are associated with the Price River Formation in the Project Area; however, springs issue from the formation in adjacent areas (Thiros and Cordy 1991). Groundwater naturally discharges from the Castlegate Sandstone and the Blackhawk Formation in the Project Area. Only one seep issues from the Star Point Sandstone.

With the exception of four springs at the head of Link Canyon, all of the springs in the Project Area discharge in Box Canyon and East Fork Box Canyon, which dissect the plateau. Without exception, springs in Box Canyon and East Fork Box Canyon issue from the east or northeast canyon walls. This is a result of the structural control on groundwater flow (i.e., groundwater flow is in the down-dip direction).

Three distinct types of groundwater systems exist in the Project Area. These systems are:

- Colluvial groundwater systems
- Castlegate Sandstone groundwater systems
- Blackhawk Formation groundwater systems

Each of these systems is described below.

Colluvial groundwater systems are found on the lower canyon walls of Box Canyon and East Fork Box Canyon. Although no springs are associated with colluvial materials, abundant phreatophytes growing from these materials suggest that the colluvium is storing and transmitting water. Colluvial groundwater systems are recharged by surface flow during snowmelt runoff and

rainstorms and by discharge from the bedrock groundwater systems. These porous and permeable materials have a large water storage capacity, but drain quickly because of the high permeability of the unconsolidated sediments.

Castlegate Sandstone groundwater systems occur near cliff faces in Link Canyon and Box Canyon. Low discharge rates (Mayo and Associates 1998) and lack of groundwater in the Castlegate Sandstone in drill holes and wells indicate that there is not an areally extensive groundwater system, but rather these systems are localized and are not interconnected hydraulically. Chemical and discharge rate data suggest that recharge to these systems occurs on the mostly flat plateau areas near cliff exposures. The chemical composition of Castlegate Sandstone groundwaters is consistent with recharge directly on relatively barren exposures of the sandstone and is not consistent with waters that have been in contact with the soil zone or the overlying Price River Formation. Groundwater flow occurs in fractures and in the intergranular spaces of weathered bedrock that has increased porosity and permeability due to dissolution of carbonate mineral cement. The flux of water in Castlegate Sandstone groundwater systems is strongly dependent on recharge events, as indicated by modern isotopic contents and discharge hydrograph data. Without seasonal recharge, discharge from the Castlegate Sandstone would quickly cease.

Due to the discontinuous occurrence of groundwater in the Castlegate Sandstone and the low porosity and permeability of the tightly cemented sandstone, the formation is not suitable for development of a water supply. No water supply wells exist in the Project Area and none are planned.

Groundwater in the upper portion of the Blackhawk Formation issues from springs in Box Canyon. These springs commonly occur at the contact of sandstone with shale or mudstone. Groundwater systems in the Blackhawk Formation are not recharged by downward flow from the overlying Castlegate Sandstone. Recharge to Blackhawk Formation groundwater systems likely occurs where the Blackhawk Formation is exposed on the canyon walls and the plateau escarpment. This is indicated by the difference in the $\delta^{13}\text{C}$ compositions between Castlegate Sandstone and Blackhawk Formation groundwaters. This difference may be the result of different vegetation types in the recharge areas. Castlegate Sandstone groundwater systems are recharged in the immediate vicinity of the canyon walls where sagebrush communities are found, while exposures of the Blackhawk Formation support conifer communities. That groundwater recharge to the Blackhawk Formation does not occur through the Castlegate Sandstone is also supported by results of geochemical modeling that indicate that it is not possible to naturally evolve from Castlegate Sandstone groundwater to Blackhawk Formation groundwater. The absence of water in well 89-16-1W and coal exploration holes also suggests that the Castlegate Sandstone is not transmitting significant quantities of water downward and is not a potential source of recharge to the Blackhawk Formation.

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Shale and mudstone layers in the Blackhawk Formation do not support significant groundwater flow and are responsible for preventing downward migration of water from the Castlegate

Sandstone. Blackhawk Formation groundwater systems are supported by sandstone paleochannels. Groundwater recharge occurs directly to these sandstone bodies where they crop out at the land surface. Groundwater movement is gravity-driven in the down-dip direction within channels. Vertical or horizontal hydraulic communication between sandstone channels is prevented by the shale and mudstone layers that encase sandstone channels.

Groundwaters that discharge from Blackhawk Formation systems in Box Canyon have radiocarbon ages ranging from modern to 4,000 years. Both modern groundwaters and groundwaters with antiquity have similar solute compositions, $\delta^{13}\text{C}$ compositions, and mineral saturation index values. What this means is that both modern and older groundwaters have similar recharge mechanisms and flow through similar rock types, but the length of the flow path varies due to recharge occurring at different locations along the canyon walls and plateau escarpment.

Groundwater discharge is greatest in the upper 200 feet of the formation, or 600 feet to 800 feet above the mined coal seam. Figure 3-7 is a graph of spring discharge rates plotted against stratigraphic position relative to the mining horizon. Groundwater discharge from the lower 600 feet of the formation is considerably less than the discharge in the upper 200 feet. Most of the discharge in the lower portion of the Blackhawk Formation issues from Pines 303, which occurs about 150 feet above the mining horizon. The upper portion of the Blackhawk Formation contains thicker and more laterally continuous sandstone channels (Marley et al., 1979). The general lack of groundwater flow in the lower part of the formation is due to thinner, less laterally continuous sandstones and abundant shales and mudstones. Coal mining in the Project Area would potentially encounter the groundwater systems of the lowermost Blackhawk Formation; however, there are no indications that water discharges from this horizon in the Project Area.

Mayo and Associates (1997a) have shown that in the SUFCO Mine area, groundwater systems in the lowermost Blackhawk Formation are highly compartmentalized both horizontally and vertically. Variations in roof drip chemistry and the steady declines in roof drip rates after cessation of mining demonstrate that there are limited horizontal hydraulic connections between the various groundwater systems. The age of the groundwater (7,500 years to 12,000 years), the perched water zones identified by Thiros and Cordy (1991) in the overlying horizons, and the rapid decline in roof drip rates suggests that the lower Blackhawk Formation has a poor hydraulic connection with potential recharge areas including the land surface and overlying saturated horizons.

The horizontal and vertical compartmentalization of the groundwater systems in the lower Blackhawk Formation suggests that mining will rapidly dewater any groundwater system encountered just above the coal seam but will have a limited effect on groundwater and surface water systems above that layer.

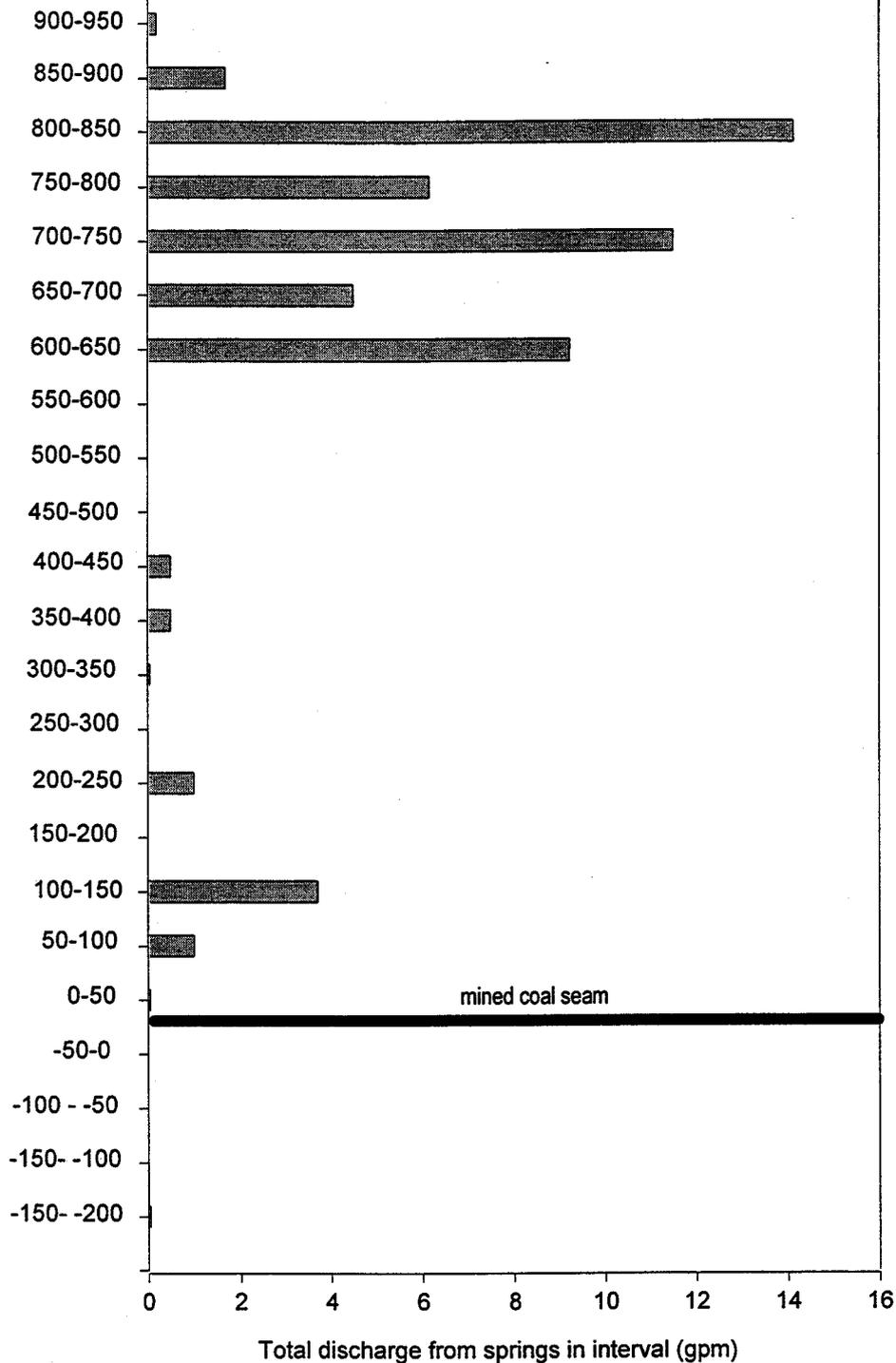
Castlegate Sandstone

Upper Blackhawk Formation

Lower Blackhawk Formation

Star Point Sandstone

Vertical separation to coal seam (feet)



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FIGURE 3-7
PLOT OF TOTAL SPRING DISCHARGE RATES IN
THE INTERVALS ABOVE THE MINED COAL SEAM

SCALE	NTS	DATE DRAWN	4/21/98	LAST REVISION	7/28/98
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Water Rights

Analysis of water rights information (Canyon Fuel 1997) indicates that water rights are associated with three springs in the Pines Coal Lease Tract. There are no water rights for springs in the Permit Amendment Area or Lease Modification Area. Water rights for springs in the Pine Coal Lease Tract are listed below.

Water Right	Baseline ID	Quantity cfs	Use	Owner	Description
94-428	Pines 101	0.0110	Stock watering	USDA-FS	Link Canyon Spring #1
94-429	Pines 102	0.0110	Stock watering	USDA-FS	Link Canyon Spring #2
94-591	GW-21	0.0110	Stock watering	USDA-FS	Link Canyon Spring

3.2.2 Environmental Consequences

3.2.2.1 *No Action Alternative*

Under this alternative, the Pines Coal Lease Tract would not be offered for lease, subsidence of Box Canyon would not be allowed, and mining would not be allowed in the Lease Modification Area. Thus, there would be no mining-related impacts to groundwater resources.

3.2.2.2 *Alternative B*

There are two mechanisms for adversely affecting groundwater systems overlying the mining horizon and the natural groundwater discharge rates from these systems. First is the direct interception of groundwater by mine workings. Mining has the potential to decrease the discharge from groundwater systems whose flow paths include the mined coal seam or horizons immediately above or below the coal seam. It is unlikely that this will be an impact to groundwater resources in the Project Area for several reasons.

First, groundwater does not naturally discharge from the coal horizon where it crops out at the land surface. Although one seep, Pines 205, discharges immediately above the coal seam to be mined, based on field observations, this water appears to be associated with the soil mantle (because the flow from this spring is small, the age of water discharging from this seep has not been determined). It is possible some groundwater may discharge directly into Box Canyon Creek. However, it is doubtful that discharge directly to the creek is consequential because discharge is not seen elsewhere along the coal outcrop.

Second, groundwaters encountered in the SUFCO Mine have groundwater ages between 7,500 years to 20,000 years (Mayo and Associates 1997a; 1997b). What this means is that under natural conditions, groundwater flow in the coal-bearing horizon of the Blackhawk Formation is extremely slow. The natural discharge locations of groundwater systems encountered in the coal horizon by mine workings have not been identified. Water that naturally discharges from these

systems would have radiocarbon ages in excess of 7,500 years to 20,000 years. Three Blackhawk Formation springs (Pines 204, Pines 206, Pines 303) in Box Canyon have radiocarbon ages of 500 years to 4,000 years; however, these springs occur 100 feet or more above the coal horizon and should not be impacted by the direct interception of water in the mining horizon because of shale and mudstone horizons in the interburden between the mining horizon and the sandstone channels that support these springs. (Although these springs would not be impacted by the *direct interception* of water in the mining horizon, they would potentially be impacted by subsidence and fracturing, which is discussed in subsequent paragraphs.)

The other method of adversely affecting natural groundwater discharge rates results from interruption and deformation of strata above longwall panels. The relationship of fracture height equal to 30 times mining height is commonly applied in western coal mines (Kadnuck 1994). This relationship predicts that fracturing above longwall panels in the Project Area will be about 330 feet (assuming a mining height of about 11 feet). Above this interval, continuous bending of strata generally occurs and preexisting fractures can dilate in response to bending and cause flow variation. However, as has been observed in the SUFCO Mine area, tension cracks are common in the brittle Castlegate Sandstone even though the sandstone is about 800 feet to 1,000 feet above the mine workings. There is no evidence to suggest that these fractures extend from the mined horizon to the surface.

The springs that issue from the Castlegate Sandstone at the head of Link Canyon should not be impacted by mining. These springs overlie the abandoned Link Canyon Mine workings and will not be directly undermined. The discharge from spring GW-21 is highly dependent on seasonal recharge events, indicating that this spring is not part of an areally extensive groundwater system that could be impacted by mining in other portions of the Project Area. Springs Pines 100, 101, and 102 are probably not unlike GW-21 because of similar stratigraphic and topographic location, and should not be affected by mining in the Pines Coal Lease Tract.

In the Pines Coal Lease Tract, a number of springs that discharge in Box Canyon and East Fork Box Canyon would be undermined under this alternative. These springs, along with diffuse discharge from colluvial groundwater systems, support baseflow of the creek in East Fork Box Canyon. These springs and the thickness of the overburden separating these springs from the mining horizon are listed below.

Spring	Overburden (feet)	Spring	Overburden (feet)
Pines 307	330	Pines 105	830
Pines 213	672	Pines 311	825
Pines 214	695	Pines 310	870
Pines 215	710	Pines 103	850
Pines 216, 216A	735	SUFCO 089	830
Pines 217, 217A	765		

With the exception of Pines 307, these springs issue from horizons more than 600 feet above the anticipated height of bedrock fracturing and should not be impacted by fractures emanating from the mining horizon. Groundwater systems that supply water to these springs could be affected by the dilation of preexisting natural fractures or tension cracks, which generally occur above longwall panel margins and ends. Four of these springs, Pines 213, 214, 215, and 216, discharge from the Blackhawk Formation. These springs are at the greatest risk to be affected by subsidence. If spring flow were diverted or recharge paths altered, the potential exists for diverting a total of approximately 4 gpm of groundwater discharge from surface drainages if all these springs were adversely affected. Shales and mudstone layers containing swelling clays in the Blackhawk Formation should heal dilated fractures and tension cracks, thereby preventing significant downward migration of water and making impacts to the discharge rates of these springs unlikely.

Because Pines 307 is underlain by just over 300 feet of overburden, the risk to this spring is substantial. However, discharge from this spring is meager (in June 1997 the spring area was damp, and in October 1997 the spring was dry), thus if mining caused the discharge from this spring to cease, the impact would be inconsequential.

Immediately adjacent to the Lease Modification Area, a number of springs discharge to Box Canyon from the Castlegate Sandstone and Blackhawk Formation (Figure 3-4). This section of Box Canyon supports the highest concentration of springs within the study area and these springs contribute a substantial proportion of the baseflow of Box Canyon Creek (approximately 30 gpm). Therefore, the potential for mining-related impacts to groundwater resources is greater in this area than in any other portion of the Project Area. Mining-related fracturing and subsidence could affect the recharge areas and flow paths of springs that discharge adjacent to the Lease Modification Area. However, all of these springs discharge where the overburden thickness is greater than 720 feet. Therefore, it is unlikely that any of these springs would be affected by mining.

Groundwater systems in the Castlegate Sandstone are localized, as indicated by low discharge rates and seasonal discharge variations. Fracture dilation or tension crack formation that occurs in the vicinity of a Castlegate Sandstone spring could divert groundwater flow that supports the spring. Because East Fork Box Canyon is a natural groundwater discharge area, water that is diverted by fractures would not be lost but would likely discharge lower in the formation. Because all Castlegate Sandstone springs in East Fork Box Canyon discharge in the canyon bottom, lower in the formation equates to further downstream. It is not possible to quantify the distance that discharge locations may shift. If the discharge location of a spring shifts, riparian vegetation at the original discharge location may be impacted. However, increased riparian vegetation would be supported at the new discharge location.

In only one instance has a spring been undermined at the adjacent SUFCO Mine (Mayo and Associates 1997b). This spring, SUFCO 001, was undermined in 1981 by a continuous miner

panel. The spring discharges from the upper Blackhawk Formation. Hydrograph data do not suggest that this spring has been impacted by underground mining (Mayo and Associates 1997b). Although no instance where mining has adversely impacted a spring in the Wasatch Plateau is known, it is difficult to draw comparisons between the potential impacts to Castlegate Sandstone springs in the Project Area and mining-related impacts to springs elsewhere in the Wasatch Plateau. The Project Area is unique in the Wasatch Plateau because the Castlegate Sandstone is exposed at the surface over such a large portion of the Project Area.

Groundwater should not be diverted from the Castlegate Sandstone into the Blackhawk Formation. There is a natural hydraulic disconnect between the Castlegate Sandstone and the Blackhawk Formation. Information from monitoring wells (Mayo and Associates 1997a) in the Quitchupah Lease suggests that this hydraulic disconnect remains intact after subsidence. Well 89-20-2W is located about 1.5 miles southwest of upper Box Canyon and is screened from 67 to 170 feet below ground surface; the water level is about 150 feet below the ground surface. This well occurs at the edge of a longwall panel where tensile stresses are the greatest and the formation of tension cracks is most likely. Nevertheless, when this well was undermined in September 1991, the water level remained wholly unaffected. The water level has remained constant to date, indicating that if tension cracks formed in the vicinity of this well, these cracks have neither dewatered this saturated horizon of the Castlegate Sandstone nor increased the recharge to the Castlegate Sandstone. The water levels in two other monitoring wells, US77-8 and US80-4, remained constant during and for several years after these wells were undermined.

The unstable isotopic composition of water from a sealed longwall gob area in the SUFCO Mine also suggests that subsidence-related fracturing has not induced the downward movement of modern, overlying groundwaters into the mine (Mayo and Associates 1997a). Mining ceased in this longwall area in 1989, and the outflow from this area has steadily decreased since that time. When sampled in 1996, the outflow from this subsided area had a mean ^{14}C age of 13,000 years and contained no tritium. If groundwaters from shallow, overlying systems (which contain anthropogenic carbon and tritium) were intercepted by subsidence fractures and were flowing downward into the mine, some of modern water would be expected in this sample.

Although springs that discharge in lower Box Canyon are west of the Pines Coal Lease Tract (Figure 3-4) and will not be directly undermined, some of these springs, especially those with antiquity, may discharge from systems whose flow paths include strata above the proposed mining area. Mining-induced bedrock fracturing of sandstone paleochannels in the Blackhawk Formation may potentially divert flow from these channels into underlying strata. Discharge from Pines 303 would possibly be impacted by mining, representing a 3 gpm loss if the entire discharge from this spring ceased. This spring issues 100 feet stratigraphically above the coal seam and discharges water that has a radiocarbon age of 3,500 years to 4,000 years. This indicates that the recharge area for this groundwater system is some distance from Box Canyon, and the flow path likely includes strata overlying the Pines Coal Lease Tract. The destination of water that is diverted from overlying strata is unknown. However, clays in Blackhawk Formation shales and mudstones

swell when wetted and anneal mining-induced fractures. Thus, the downward migration of groundwaters is naturally mitigated. This occurrence is suggested by the fact that the discharge from mined-out longwall areas in the SUFCO Mine and other Wasatch Plateau mines consistently decrease with time.

In the event that groundwater discharge rates are impacted, Utah Code 40-10-18 requires the operator to “promptly replace any state-appropriated water in existence prior to the application for a surface coal mining and reclamation permit.” Replacement of culinary sources is required by SMCRA, which is administered by UDOGM. These regulations do not require the replacement of water necessary to sustain ecosystems in the affected area, nor do they stipulate that water be replaced at the source (i.e. spring or seep location). What this means is that the lessee could adversely impact non-appropriated and non-culinary groundwater resources and not be required to replace the impacted water.

Fracturing of bedrock on the surface of the upland areas surrounding the canyons may increase recharge to Castlegate Sandstone groundwater systems. Mining-induced fractures may enhance pre-existing recharge locations and/or provide additional recharge locations. Water that is intercepted by fractures will be almost exclusively transmitted by and stored within fractures. The well-cemented nature of the Castlegate Sandstone will prevent the sandstone from receiving and transmitting much water. Nonetheless, fractures could significantly increase the storage volume of the bedrock groundwater system. Increasing the flux of water through the bedrock groundwater system and the storage volume of this system could increase baseflow discharge to Box Canyon Creek.

Diffuse groundwater discharge supports vegetation growing in bedding planes and fractures on lower canyon walls in the head of the upper left fork Box Canyon in the SE $\frac{1}{4}$ of Section 15, T. 21 S., R. 5 E. The potential impacts to this diffuse groundwater discharge are uncertain. Discharge from bedding planes and fractures may increase, as discussed in the previous paragraph, due to increased recharge to the Castlegate Sandstone resulting from fracturing on the plateau. Conversely, this discharge may be diminished or hindered by induced fractures that divert water from these discharge locations. If discharge is diminished or hindered, the vegetation that is supported by diffuse groundwater discharge from bedding planes or fractures could suffer.

Possible Diversion of Surface Water into Bedrock by Fracturing

The formation of subsidence-induced tension cracks in the Castlegate Sandstone at the surface is not uncommon and has been observed above the workings of the SUFCO Mine. Similarly, tension cracks are expected to form as a result of longwall mining in the Project Area. The most probable locations for the formation of surface tension cracks are above panel margins and panel ends where tension is greatest due to the upward inflections of subsidence troughs (Goodrich and Agapito 1997). The orientation of tension cracks in these zones will be approximately parallel to the gateroads (north-south) and panel ends (east-west). Surface cracks are also possible above the dynamic tension zone that will develop parallel to and north of the longwall face (Goodrich

and Agapito 1997). Such tension cracks were recently observed above a longwall panel in the adjacent Quitchupah Lease in May 1998. This tension zone will be several hundred feet wide and will progress with panel retreat. Because tension cracks generally take time to develop (1-2 months following mining) and panel retreat is relatively fast, tension cracks that form in the dynamic stress zone will be less severe and will likely close as the panel retreats and tensile stresses are relieved.

Mayo and Associates (1997b) described tension cracks that affect ephemeral drainages. Cracks were observed in the vicinity of two stock watering ponds in the adjacent Quitchupah Lease, south of the Pines Coal Lease Tract. Cracks occurred along the outflow of Rock Pond and near Johnson Pond. These areas were visited on a rainy day, which facilitated observations of hydrologic impacts. Sediments filled tension cracks and water ponded in and above filled tension cracks in the Rock Pond outflow. A tension crack was observed above the end of a longwall panel that was filled by sediments and organic litter and water ponded above this crack following a rain storm. However, a tension crack at Johnson Pond was observed to intercept overland flow during an intense downpour, and tension cracks that were recently observed (USDA-FS, 1998b) in the ephemeral drainage near Rock Pond had not healed after 2 years and were diverting surface flow. The destination of waters intercepted by tension cracks has not been determined.

These observations suggest that tension cracks will intercept surface flows in the absence of an adequate sediment supply to fill the fracture or adequate flow to carry sediment to the fracture. Otherwise, tension fractures in ephemeral drainages fill with sediments and become an insignificant disruption to the hydrologic balance. Observations suggest that tension cracks fill with sediment within a relatively short period of time, likely during the first substantial precipitation and runoff event following crack formation.

Under this alternative, the perennial stream in East Fork Box Canyon would be undermined with longwall methods. Mayo and Associates (1997b) have specifically described potential longwall-mining-related impacts to streamflow in the upper reaches of Box Canyon where the Castlegate Sandstone outcrops in the canyon bottom. However, data similar to those used by Mayo and Associates in describing the impacts to upper Box Canyon Creek are not available for East Fork Box Canyon. Nevertheless, the findings of Mayo and Associates (1997b) can be extrapolated to East Fork Box Canyon where the Castlegate Sandstone outcrops. This extrapolation is possible because of similar stratigraphy, structure, geomorphology, and canyon orientation relative to longwall panels. The Pines Coal Lease Tract includes a reach of East Fork Box Canyon where the Blackhawk Formation outcrops in the stream bottom. The potential effects of longwall mining under this reach are analyzed, to the extent possible, in this document.

Tension cracks that may occur in the bottom of East Fork Box Canyon may cause recharge to bedrock underlying the canyon at the direct expense of streamflow and water in colluvial groundwater systems. The magnitude of this potential impact ranges from little, if any, diminution of creek flow to the interception of appreciable creek flow. The magnitude of