2004 ANNUAL REPORT

CANYON FUEL COMPANY, LLC
SUFCO MINE
ACT/041/002

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2004 Annual Report
Refer to Record No 0022 Date 03292005
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*To enter text, click in the box and type your response. If a box already contains an entry select the entry and type the replacement. You can use the **tab** key to move from one field to the next. To select a check box, click in the box or type an x.*

GENERAL INFORMATION

Permittee Name	Canyon Fuel Company, LLC
Mine Name	SUFCO Mine
Operator Name (If other then permittee)	
Permit Expiration Date	05/20/2007
Permit Number	C/041/002
Authorized Representative Title	Kenneth E. May, Mine Manager
Phone Number	(435) 286-4880
Fax Number	(435) 286-4499
E-mail Address	kmay@archcoal.com or mdavis@archcoal.com
Mailing Address	397 South 800 West, Salina, UT 84654
Designated Representative	C. T. Corporation
Resident Agent	Corporation Trust Center
Resident Agent Mailing Address	1209 Orange Street, Wilmington, DE
Number of Binders Submitted	1-Salt Lake City and 1-Price Field Office

IDENTIFICATION OF OTHER PERMITS

Identify other permits that are required in conjunction with mining and reclamation activities.

Permit Type	ID Number	Description	Expiration Date
MSHA Mine ID(s)	4200089	Minesite	
	1211UT090008901	Waste Rock Disposal	
MSHA Impoundment(s)			
NPDES/UPDES Permit(s)	UT0022918	Minesite Sediment Pond Major Industrial	April 30, 2006
	UTR000576	Multi-Sector Storm Water Permit	December 31, 2006
PSD Permit(s) (Air)	DAQE-AN0665006093	Minesite Air Quality Approval Order	
	BAQE-126-88	Waste Rock Disposal Air Quality Approval Order	

Other

CERTIFIED REPORTS

List the certified inspection reports as required by the rules and udder the approved plan that must be periodically submitted t the Division. Specify whether the information is included as Appendix A to this report or currently on file with the Division.

Certified Reports:	Required		Included or on file with DOGM		Comments
	Yes	No	Included	On File	
Excess Spoil Piles	☐	☒	☐	☐	
Refuse Piles	☒	☐	☐	☒	Certified Reports prev. submitted
Impoundments	☒	☐	☐	☒	Certified Reports prev. submitted
Other					
_____	☐	☐	☐	☐	_____
_____	☐	☐	☐	☐	_____

REPORTING OF OTHER TECHNICAL DATA

List other technical data and information as required under the approved plan, which must be periodically submitted to the Division. Specify whether the information is included as Appendix B to this report or currently on file with the Division.

Technical Data:	Required		Included or on file with DOGM		Comments
	Yes	No	Included	On file	
Climatological	☒	☐	☒	☐	Included on disk in Appendix B
Subsidence Monitoring	☒	☐	☒	☐	Included in Appendix B
Vegetation Monitoring	☒	☐	☒	☐	Included in Appendix B
Raptor Survey	☒	☐	☒	☐	Included in Appendix B
Soils Monitoring	☐	☒	☐	☐	
Water Monitoring	☐	☐	☐	☐	
First quarter	☐	☒	☐	☐	
Second quarter	☒	☐	☐	☒	Data previously submitted
Third quarter	☒	☐	☐	☒	Data previously submitted
Fourth quarter	☒	☐	☐	☒	Data previously submitted
Geological / Geophysical	☐	☒	☐	☐	
Engineering	☐	☒	☐	☐	
Non Coal Waste / Abandoned Underground Equipment*	☐	☐	☐	☐	
Other Data					
East Fork of Box Canyon Monitoring	☒	☐	☒	☐	Included in Appendix B
Macroinvertibrate Study of East Fork	☒	☐	☐	☐	Macroinvertibrate Study will be submitted when Consultant completes it.
2004 Cultural Resource	☐	☒	☒	☐	Included in Appendix B

*Reminder: If equipment has been abandoned during 2004, an amendment must be submitted that includes a map showing its location, a description of what was abandoned, whether there were any hazardous or toxic materials and any revision to the PHC as necessary.

LEGAL, FINANCIAL, COMPLIANCE AND RELATED INFORMATION

Change in administration or corporate structure can often bring about necessary changes to information found in the mining and reclamation plan. The Division is Requesting that each permittee review and update the legal, financial, compliance and related information in the plan as part of the annual report. Please provide the Department of Commerce, Annual Report of Officers, or other equivalent information as necessary to ensure that the information provided in the plan is current. Provide any other change as necessary regarding land ownership, lease acquisitions, legal results from appeals of violations, or other changes as necessary to update information required in the mining and reclamation plan. Include certified financial statements, audits or worksheets, which may be required to meet bonding requirements. Specify whether the information is currently on file with the Division or included as Appendix C to the report.

Legal / Financial Update	Required		Included or on File with DOGM		Comments
	Yes	No	Included	On file	
Department of Commerce, Annual Report Officers	☒	☐	☐	☒	Submitted in Canyon Fuel Co. General Chapter One
Other					
	☐	☐	☐	☐	
	☐	☐	☐	☐	
	☐	☐	☐	☐	

MINE MAPS

Copies of mine maps, current and up-to-date through at least December 31, 2004, are to be provided to the Division as Appendix D to this report in accordance with the requirements of R 645-301-525.240. These map copies shall be made in accordance with 30 CFR 75.1200 as required by MSHA. Upon request, the Division shall keep mine maps confidential. Please provide a CD.

Map Number(s)	Map Title/ Description	Confidential	
		Yes	No
	Mining Progress 2004-2005	☒	☐
		☐	☐
		☐	☐
		☐	☐
		☐	☐
		☐	☐
		☐	☐
		☐	☐
		☐	☐
		☐	☐
		☐	☐

OTHER INFORMATION

Please provide any comments of further information to be included as part of the Annual Report. Any other attachments are to be provided as Appendix E to this report. If information is submitted as a group rather then by individual mine, please identify each of the mine's data in the list below.

Additional attachment to this report? **Yes** ☐ **No** ☒

APPENDIX A

Certified Reports

Excess Spoil Piles
Refuse Piles
Impoundments

As required under R645-301-514

CONTENTS

None - Certified Reports previously submitted.

APPENDIX B

Reporting of Technical Data

Including monitoring data, reports, maps, and other information
As required under the approved plan or as required by the Division

In accordance with the requirement of R645-310-130 and R645-301-140

CONTENTS

2004 SUBSIDENCE REPORT

CANYON FUEL COMPANY, LLC

SUFCO MINE

by

JOHN M. BLACK

CHIEF SURVEYOR

INTRODUCTION

Canyon Fuel Company LLC, SUFCO Mine's 2004 subsidence report is an update of annual subsidence data that has been accumulated since 1976 as the former Southern Utah Fuel Company. Prior to 1985, the data was derived from conventional survey methods. Since then, photogrammetric surveys have been employed to monitor the ground movement.

During 1985, the entire SUFCO Mine property was flown to establish a set of baseline photography and a grid of surface elevations. Where possible, an elevation was photogrammetrically determined on an approximate 200-foot grid. These original x, y and z locations serve as a comparative base for determining ground movement in the succeeding years. Other lease holdings that are acquired are flown for similar baseline information. Lease U-63214 was flown in 1991 and the 150-acre modification to lease U-63214 and lease UTU-76195 were flown in 1999.

Once each year around the end of August, another set of aerial photography is obtained. A new elevation is then found at the same x and y coordinates as all the originals within all areas considered to be active. The new, or current, elevations are compared to the originals and the difference between the two is used to generate a contour map. The result is the subsidence contour map included with each annual subsidence report.

The mine subsidence map accompanying this report shows surface control monuments, overburden contours, subsidence contours, surface tension cracks, a current outline of the mine, a one year mining projection and other miscellaneous items as explained in the legend.

SUBSIDENCE HISTORY

SUFCO Mine began operations that cause surface subsidence in June, 1976. Continuous miners were used to extract coal from pillars that were developed as part of a retreating panel. The panels were approximately 650 feet wide and varied in length up to 2,500 feet. The average mining height approached 11 feet and the extraction ratio averaged about 80%.

The resulting subsidence from these continuous miner panels averaged 4 feet in the plateau areas where overburden was 900 feet thick. In areas where panel boundaries were outside the escarpment and beyond the Castlegate Sandstone, subsidence increased with decreasing overburden thickness. The maximum subsidence measured to date, 8.5 feet, occurred in one of these areas. The overburden was only 600 feet thick.

Retreat mining continued in this manner until October, 1985, when a retreating longwall system was added. Longwall panels have ranged from 550 feet to 930 feet wide and up to 18,500 feet in length. Mining heights have varied from 8.5 feet to 12 feet.

Subsidence above the longwall panels has averaged 5 feet in the center of the panels. The overburden thickness has been from 1,800 feet to 1,000 feet (except outside the escarpment where overburden rapidly decreases). The maximum measured subsidence caused by longwall mining is seven feet. This occurred in two cases; 1. An area outside the escarpment very similar to the one mentioned above for the continuous miner panel and 2. Down the center of panels that are under plateaus with 1,000 feet of overburden, but this is not typical.

DORMANT AND ACTIVE AREAS

Dormant areas are those areas that have shown no movement for several consecutive years. Yearly digitizing of these areas will not be done, but photographic coverage can be obtained in the event that a need should arise for reevaluation. These areas may not be shown on the current subsidence map.

Active areas are those currently being mined or that have evidence of movement within a reasonable time period. Active areas are digitized and evaluated for subsidence yearly, until they meet the parameters of a dormant area.

2004 SUBSIDENCE

The 2003 subsidence map (Map 1) was updated using data from current photogrammetric monitoring. Each subsidence area is labeled as an independent block. A brief description of each follows:

AREA 1

This was SUFCO Mine's first subsidence area. Undermining began in June, 1976, and continued into 1979. The area is composed of five continuous miner panels that averaged 650 feet in width. Mining height averaged 11 feet with about an 80% extraction ratio.

Subsidence ranged from 4.5 feet to a maximum of 8.5 feet. It was first detected in 1976 and continued until 1985. No surface movement was detected in this entire area from 1986 to 1989. Area 1 was not digitized for the 1990 subsidence report and is considered dormant.

AREA 2

This is another continuous miner area. The panels here were irregular shaped and the extraction ratio was modest. Undermining ceased in 1984.

Maximum subsidence has been measured at 2 feet. The area has been stable since 1985 and has not been monitored since 1989. This area is dormant.

AREA 3

This area is another continuous miner section, but the extracted area is a portion of mains with protective barriers instead of a panel. Coal recovery was moderate with mined areas which were subcritical. Undermining ceased in 1983.

Maximum subsidence was measured at 2 feet. Because of the limited extraction and subcritical areas, the subsidence occurred slowly with small changes noticeable until 1987. The area appeared stable in 1988 and 1989. It has not been monitored since 1989 and is considered dormant.

AREA 4

This subsidence area is comprised of three continuous miner panels. The mining height averaged 11 feet with a good extraction ratio. Undermining ceased in 1985.

Maximum subsidence was 5 feet with no detectable change in 1989. This area was monitored again in 1993, 1994 and 1995 with no detectable changes. This area was monitored for ten years after undermining ceased. The last detectable subsidence was in 1988. Therefore, this area will be considered dormant.

AREA 5

The four continuous miner panels that make up this area were mined from September, 1978, to November, 1981. Mining height averaged 11 feet with an 80% extraction ratio.

Maximum subsidence was 5 feet with no detectable changes from 1985 through 1991. This area has not been monitored since 1991, and will also remain dormant.

AREA 6

Area 6 is SUFCO Mine's first longwall induced subsidence area. It is comprised of nine longwall panels varying from 540 feet to 700 feet in width and 1,700 feet to 3,900 feet in length. Also, there is a section of recovered mains between two of the longwall blocks. Undermining began in Area 6 during October, 1985, and continued through the mains recovery in March, 1990.

Maximum subsidence measured in areas bounded by the plateau is five feet. There is a location on the map that shows seven feet; but this area is outside the escarpment where the overburden is only 600 feet thick. The subsided escarpment is intentional and is part of a study agreed upon by SUFCO Mine, the Division of Oil, Gas and Mining, the Bureau of Land Management and the U. S. Forest Service. This particular section of escarpment was removed from the "no subsidence zone" to study the effects of longwall mining on the escarpment.

Area 6 has shown no significant changes since 1992. It has been determined that this area is dormant.

AREA 7

Area 7 was originally planned for no subsidence. Pillars were made to support the overburden but began to fail in the north end in 1984 when the underground workings were flooded. The failures progressed towards the south and by 1986, subsidence was detected over the area.

The map shows up to seven feet of subsidence. There was no additional subsidence movement detected from 1988 to 1994. Therefore, this area will also be considered dormant.

AREA 8

Undermining this area began in June, 1983, and was sporadic until 1992. Continuous miners were used with extraction ratios over 80% and average mining heights of 10 feet. This area stayed active longer than most due to its proximity to an adjacent active longwall block.

Maximum subsidence is five feet. No noticeable vertical movement has been detected since 1993. This area is dormant.

AREA 9

This area is a longwall mining area that is composed of four panels. The first began in June, 1989 and the block was finished in January 1992. The mining height averaged about 11 feet and the maximum subsidence is five feet. There has been no indication of movement since 1996. This area is determined to be dormant.

AREA 10

Area ten is a longwall mining block that began in January 1992. Mining was completed in August 2001. The entire surface area above this block was digitized for base-line elevations during 1991. Maximum subsidence shown to date is seven feet. This area did indicate some settling movement on the top fourth of the area this year. We will monitor this area, except for the four short panels on the west side, for another year to determine its stability.

The experimental mining practice area discussed under "Area 6" was extended, with regulatory approval, to the east side of the canyon under the Southwest corner of "Area 10". An extensive pre-mining survey of this location was conducted late in 1992. A detailed survey of the post-mining subsidence effects was provided in the 1993 report.

AREA 11

Area eleven is an extension of the last longwall panel in area ten. It extends into a 150-acre modification to lease U-63214. An elevation baseline was established in 1999. Mining under this area began in January 1999 with gateroad development. Longwall mining took place from May 2000 thru September 2000. Subsidence to date shows a maximum of six feet. This area had no significant movement but monitoring will continue for another year.

AREA 12

Area twelve is the first longwall mining block on the acquired lease UTU-76195. Due to a mine plan change at the start of 2003, this area now consists of six longwall panels. An elevation baseline was established in 1999. Gateroad development began in March 2000. Longwall mining began in September 2001. The third longwall panel mining was completed in October 2004. This area is being monitored.

AREA 13

Area thirteen is the second longwall mining block on the acquired lease UTU-76195. This area was also modified and now does not contain one longwall panel. An elevation baseline was established in 1999.

DRAW ANGLE SURVEYS

Several draw angle surveys have been performed during the past years. Completed surveys have been over continuous miner areas and have been oriented both parallel and perpendicular to the long axis of the panel. The average of all measurements is 15°. Individual measurements ranged from 10° to 21°.

New longwall draw angle data was obtained in 1995. Draw angle points were installed in May 1986, on the southern end of the first panel in "Area 6". As shown on the subsidence map, survey lines were placed parallel and perpendicular to the axis of the panel. Undermining of this panel was completed in June 1986. Measurements were taken in 1995 and indicate an angle 15.25° for the perpendicular line. An angle for the parallel line was not obtained because the mains underlying the survey line were partially extracted. These findings coincide with the average of 15° as stated above.

SUBSIDENCE TENSION CRACKS

Tension cracks have occurred above most of the subsidence areas. Most have been located by survey and are shown on the map. Their lengths vary from a few feet to a couple thousand feet. Most are oriented either parallel to the natural jointing pattern or to the boundaries of the underground excavation. Vertical displacement along the cracks is uncommon and horizontal displacement varies from hairline to several inches in width depending on the surface topography (rock, hard packed or loose soil).

The U. S. Forest Service completed a tension crack study in 1978. They monitored twenty-two different cracks (located in Area 1) with widths varying from 1/8 inch to six inches. Results show that most cracks self-heal, or close, from 13% to 100% of their original width.

DETAILED LONGWALL SUBSIDENCE PROFILE

In 1998 a project was initiated to monitor longwall subsidence in relation to the advancing face. Preparation consisted of first installing two monitoring points outside the subsidence area. Then two base lines were established one 3000 feet long running parallel down the center and the second 1300 feet long perpendicular across the 967 feet wide panel. Markers were installed along these lines on 100 feet spacing using approximately 2.5 feet long rebar with an aluminum cap or a hardened nail drilled into the exposed rock. Initial horizontal and vertical readings were obtained by shooting each marker with a Topcon GTS-3 distance meter from the monitoring points.

Monitoring was done weekly to gather new readings on markers behind and up to 500 feet ahead of the advancing face. The data collected reveals that vertical movement starts approximately 150 feet ahead of the face with 15 hundredths of a foot of subsidence at the face. It then drops off quickly to 4 feet at 600 feet behind the face and gradually levels off at 4 to 5 feet. Horizontal readings indicate the ground initially moves about 30 hundredths of a foot away from the face, then back toward the face 80 hundredths of a foot.

CONCLUSION

Areas 1, 2, 3, 4, 5, 6, 7, 8, 9 are all considered to be dormant. Photographic coverage can be obtained if circumstances deem it necessary. Longwall mining of area 10 was completed in August 2001 but shows some settling at the top. Area 11 was mined in 2000 and had no movement this year. There was active longwall mining in area 12 causing subsidence. Yearly monitoring of Areas 10 (top fourth), 11, and 12 will continue until it has been determined that subsidence has ceased (on an area-by-area basis).

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PINES TRACT VEGETATION STUDY

Prepared by
Keith W. Zobell, Environmental Specialist
July 22, 2004

PINES TRACT VEGETATION STUDY

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The purpose of the "Pines Tract Vegetation Study" is to determine if under-mining of the coal reserves has had any affect on the "Link Canyon Trail Columbine" (*Aquiligia flavenscens var. rubicunda*) and the riparian areas within the Pines Tract coal lease area.

On July 15, 2004 the Pines Tract area was visited by Keith W. Zobell, Environmental Specialist. The purpose of this trip was to revisit all the photo points that have been established to retake photos at each site and determine the general vegetative growth and plant vigor, and plant condition at each of the photo sites. These photos are to become part of the visual record showing changes that occur at each site. Photos of each site are identified and included at the end of this report.

The weather records at the SUFCO Mine site showed that this area continues to receive below average precipitation during the moisture year of 2003-2004 with only approximately 80% of normal precipitation received during this period. Some good rain storms did occur in the area during April and early May which helped plant growth, however this is the sixth consecutive year that the area has been in a drought condition. This continued drought condition continues to exhibit itself in reduced flows in seeps, springs and streams as well as a reduction in plant growth and vigor in the general area. Due to the spring rains that the area received this spring the perennial plants were able to produce fair growth along with the annual plants. This vegetative over-all growth is about the same as last year. The stream in Box Canyon continues to no flow at the lower monitoring site 090. There are a few standing pools of water from station 090 up to Pines station 219 with the creek bed being totally dry above Pines station 219. The small pond at the "Grotto" area continues to be dry. The Pines tract was grazed by cattle this spring, with grazing being moderate in Box and very heavy in the East Fork of Box Canyon. The early grazing and continued drought conditions have contributed to the overall decline in plant density and vigor.

At photo point 1a there is one columbine plant with an inflorescence stem 12 inches long. The plant has fair vigor. The plant is growing out of a rock fracture and is probably getting moisture from the fracture. This plant has not been grazed.

At photo point 1b there are two plants. The plants are in full bloom with some seed heads forming and the inflorescence is 12/14 inches long. The plants are on a rock face and growing out of a rock fracture and are probably getting moisture from the fracture. Due to their location they have not been grazed and are in fair to good vigor.

At photo point 1c there were originally two live columbine plants at this site. It appears that one of the plants has died. The one live plant is in full bloom with the inflorescence stems being 8-11 inches long. These plants are also inaccessible and have not been grazed and are in fair vigor. These plants are also growing out of a rock fracture and are probably getting moisture from the fracture. These plants are more exposed to the suns rays and therefore this is probably a drier site than those at photo points 1a and 1b.

At photo point 2 there were originally three live columbine plants at this site. It now appears that two of the plants have died. The remaining live plant is in full bloom with the inflorescence stems being 8-11 inches long. These plants are inaccessible and have not been grazed and are in fair vigor. These plants are also growing out of a rock fracture and are probably getting moisture from the fracture. These plants are exposed to full sun light until afternoon and therefore this is also probably a drier site than those at photo points 1a and 1b.

At photo point 3 these columbine plants are growing at the base of the cliff face and have not been grazed. The inflorescence stems are 12-14 long and the plants are in fair+ condition.

At photo point 4 there are three columbine plants. This is a dry site and the immediate area has not been grazed. The inflorescence stems are 10-12 inches long and the vigor is fair-good. The inflorescence is in full flower with some seed heads. The new growth on adjacent plants is: Aspen 7-9 inches, Woods rose 2-3 inches, Carex sp. 3-4 inches.

At photo point 5 there are three columbine plants. This site is on the edge of the Box Canyon creek bed. Although the site has been grazed fairly heavy the columbine plants have not been grazed. These plants are in full flower with the inflorescence stems being 12-15 inches long. The plants are in fair to good vigor. The wetland carex plants have been grazed heavy with a stubble height of 1-3 inches the scattered hairgrass and bluegrass plants are also grazed heavy with a stubble height of 2-3 inches.

Photo point 6 is a riparian area in Box Canyon. This area has been heavily grazed. Ocular estimates show the site to have 50% bare ground. The Aspen sprouts have been stripped, Carex plants have a stubble height of 1-3 inches, Bluegrass plants have a stubble height of 1-2 inches, and Stipa grass has a stubble height of 3-4 inches. Overall the vigor of the plants at this site is poor which is probably due to heavy grazing and lack of moisture in the adjoining creek bed.

At photo point 7 there is no evidence of any columbine plants. The site has been heavily grazed with Carex having stubble height of 2-3 inches. There are some scattered yarrow plants. The overall condition is poor and is probably due to heavy grazing and the lack of moisture in the adjoining creek bed.

Photo point 8 is a hanging fern area. There is some moisture coming from the fractures in the rock structure and there are some ferns growing along these cracks. The ferns are 3-5 inches in length and have fair vigor. There is no evidence of cattle grazing the ferns at the time of inspection this year. There are a few dead fern plants at the site. This death loss is probably due to lack of adequate moisture.

Photo points 9a & 9b is also a hanging fern area. There is some moisture coming from the fractures in the rock structure and there are some ferns growing along these cracks. The ferns at this site are 3-5 inches and have fair vigor. There is no moss growing from the moist cracks. There is no evidence of cattle grazing. There are a few dead ferns along the moist cracks.

Photo point 10 is a riparian area in the East Fork of Box Canyon. The site has been grazed extremely heavy. This is probably due to the proximity to water coming from the flowing spring adjacent to this site. The riparian vegetation is grazed down to a stubble height on Carex of 0-1/2 inch. The only riparian with a higher stubble height is Juncus which has a stubble height of 4 inches. There are a few Rose species still existing which have also been heavily grazed. There were no dry meadow species that could be identified. Ocular survey shows that the area is 90% bare ground, 4% sagebrush, 1% Rose and 5% riparian species currently occupy the site. Additional photos were taken showing the extremely heavy grazing of the wet meadow adjacent to the photo point and of the heavy grazing inside the fenced enclosure.

Continued drought conditions continue to have adverse affects on the vegetation within the Pines tract as well as through out central Utah. Although the vigor and density of the Link Canyon Trail Columbine continues to show no improvement (or in some cases a decline) there has been no evidence identified to tie this to the under-mining of the coal reserves in this area. All evidence gathered to date indicate that the decline in the Link Canyon Trail Columbine is probably due to continued drought conditions and heavy grazing.

Photo Point 1a

Photo Point 1b

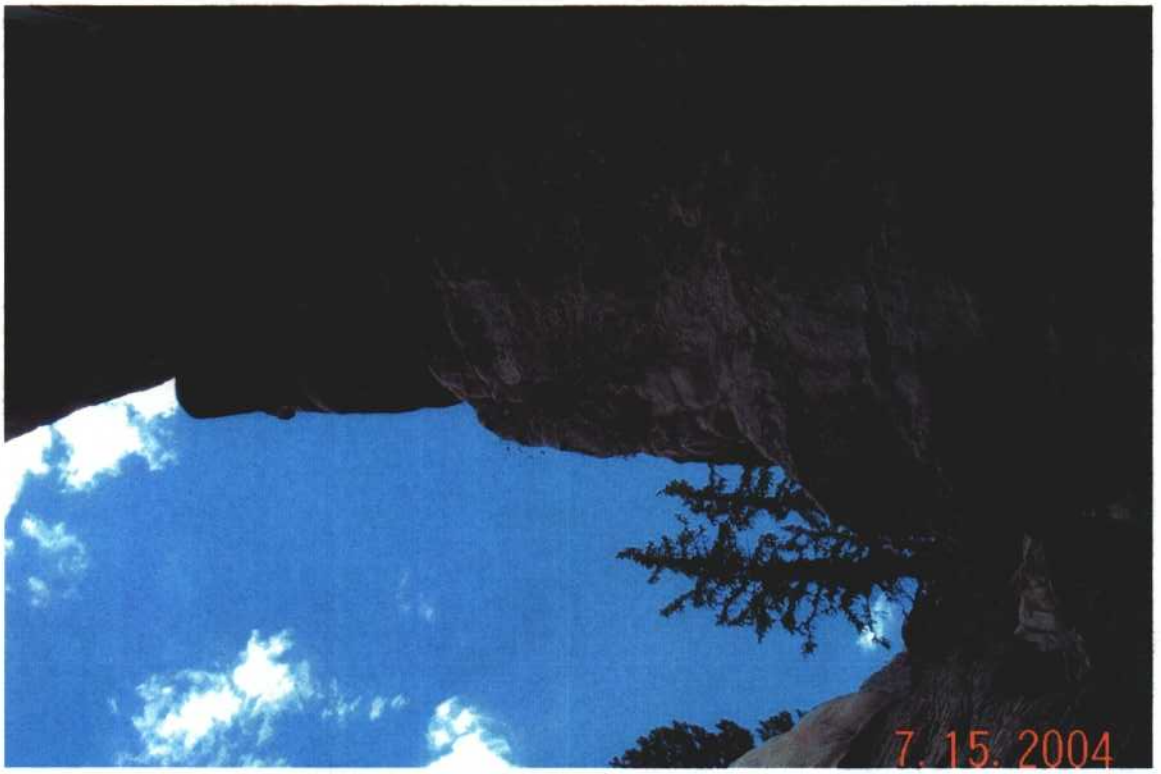


Photo Point 1c

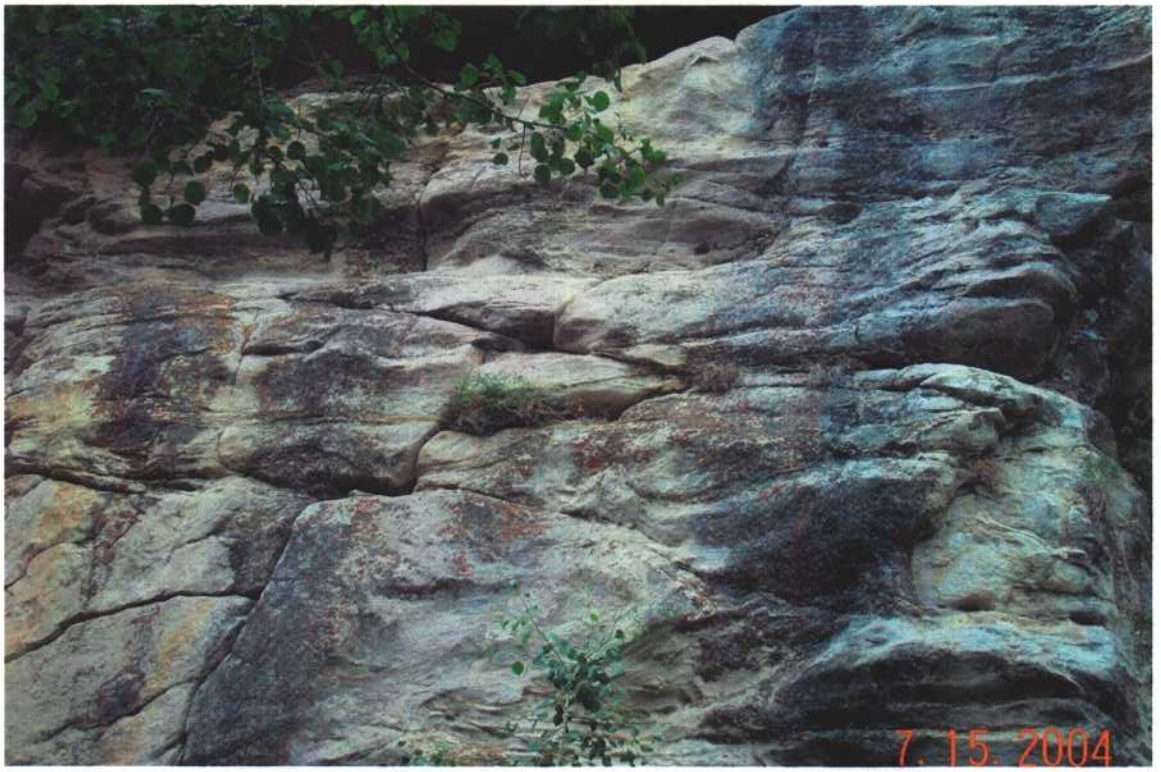


Photo Point 2

Photo Point 3

Photo Point 4

Photo Point 5

Photo Point 6

Photo Point 7

Photo Point 8

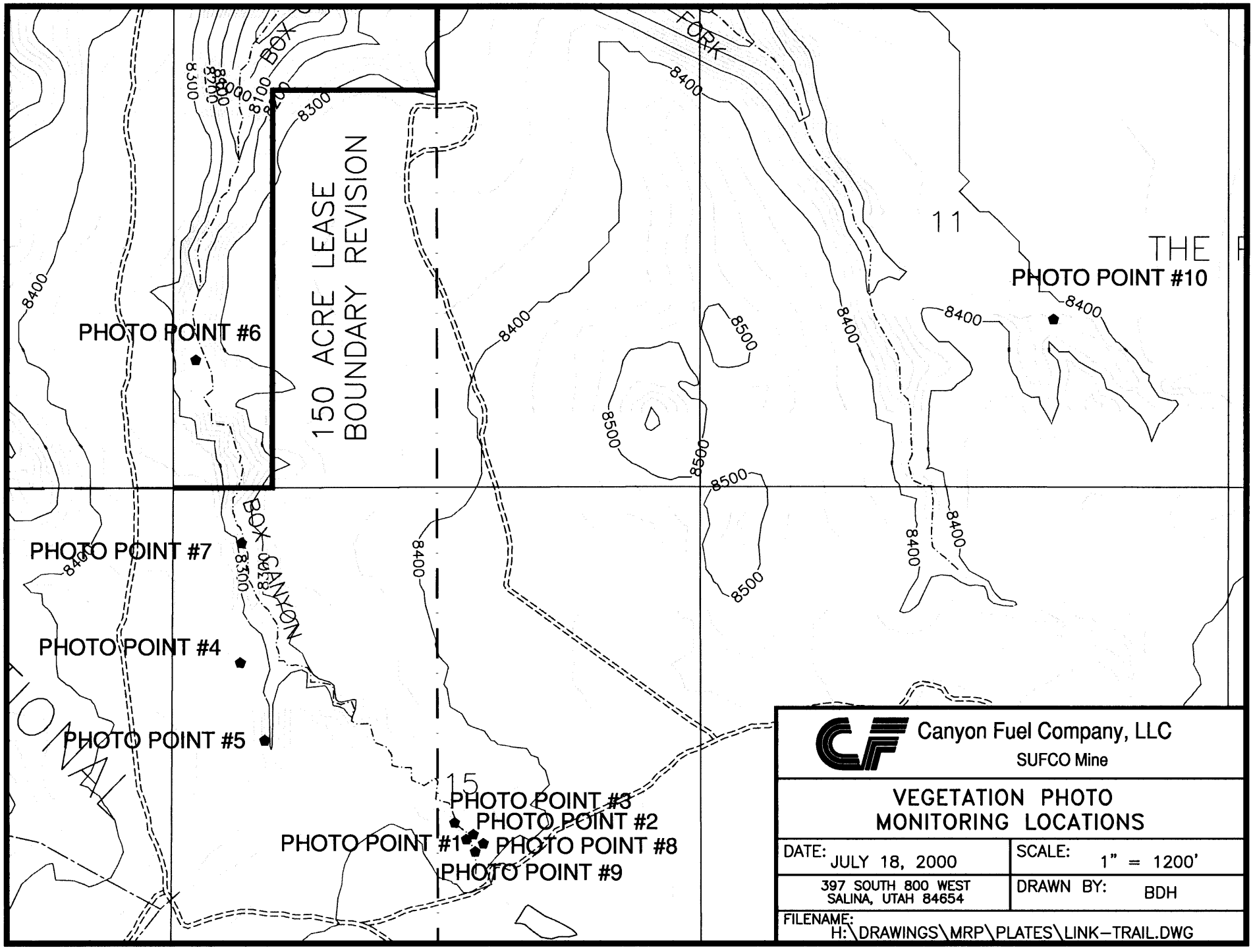
Photo Point 9a

Photo Point 9b

Photo Point 10

Riparian area adjacent to Photo Point 10

Area inside fenced enclosure at Photo Point 10



Canyon Fuel Company, LLC
SUFCO Mine

VEGETATION PHOTO MONITORING LOCATIONS

DATE: JULY 18, 2000	SCALE: 1" = 1200'
397 SOUTH 800 WEST SALINA, UTAH 84654	DRAWN BY: BDH
FILENAME: H:\DRAWINGS\MRP\PLATES\LINK-TRAIL.DWG	

Summary of Golden Eagle Nesting Surveys- 1998 -2004

Golden Eagle	Year						
	2004	2003	2002	2001	2000	1999	1998
Percent Active	6.3%	1.8%	4.5%	12.4%	18.9%	19.0%	15.3%
Number							
Active	20	6	14	35	50	47	38
Tended	23	57	32	33	27	25	74
Inactive	274	262	265	215	188	176	137
Dilapidated	62	34	45	43	47	45	56
Not Found	35	32	21	25	45	42	0
Not Surveyed	234	245	219	245	239	261	291
Total	648	636	596	596	596	596	596

Summary of Raptor Nesting Surveys - May 2004

American Kestrel Count	15
Bald Eagle Count	2
Buteo Count	15
Cooper's Hawk Count	15
Falcon Count	48
Ferruginous Hawk Count	63
Golden Eagle Count	648
Great Horned Owl Count	18
Peregrine Falcon Count	13
Prairie Falcon Count	28
Raven Count	161
Red-tailed Hawk Count	144
Unknown Count	29
Grand Count	1199

Bald Eagle	
Inactive	1
Not surveyed	1
Total	2

Red-Tailed Hawk	
Active	5
Tended	0
Inactive	40
Dilapidated	4
Not Found	17
Not Surveyed	76
Total	142

Unknown Falcon	
Inactive	6
Not Surveyed	38
Not Found	4
Total	48

Peregrine Falcon	
Active	2
Inactive	6
Not Surveyed	3
Not Found	2
Total	13

Prairie Falcon	
Active	2
Inactive	13
Not Surveyed	9
Not Found	3
Total	27

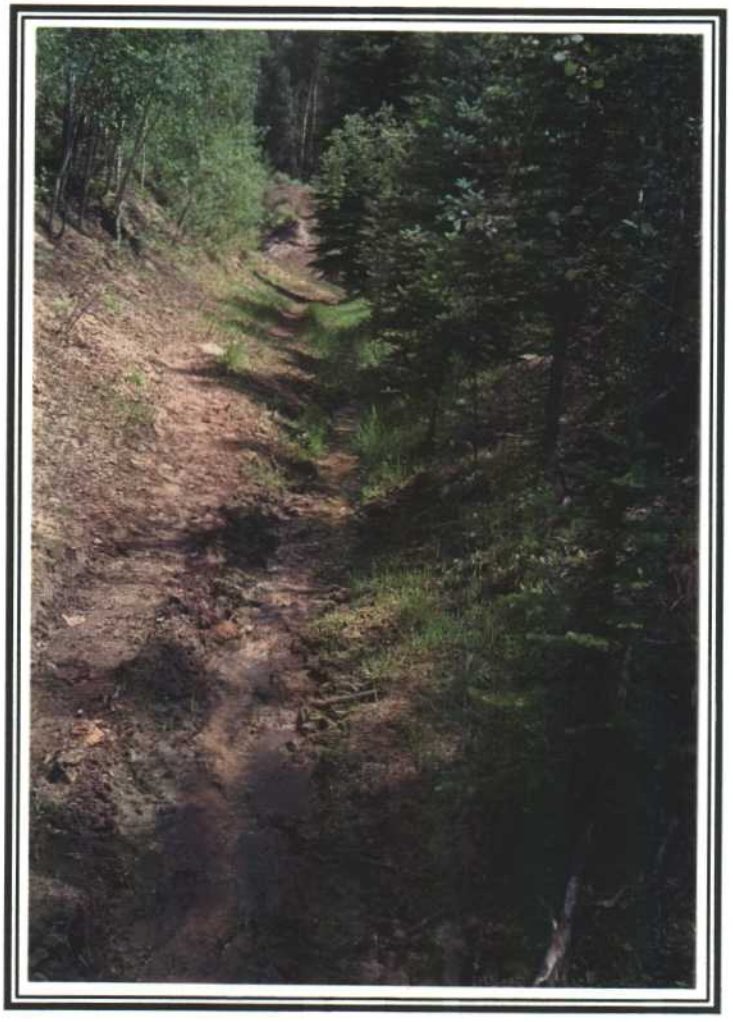
Raven	
Active	9
Inactive	45
Dilapidated	2
Not Surveyed	72
Not Found	27
Total	154

Attributes of Sufco_out04.shp

Nest_no	X_utm27	Y_utm27	Date	Species	Type	Status_04	Eggs	Yng	Age	Comments_0	Status_03	Status02	Status01	Status00	Status99	Status98	Elevation	Company	Quad
298	463459	4306434	20040527	Raven	Cliff	not found				.	inactive	Not Surveyed	Inactive	Active	Not Survey	Inactive	7500	SUFCO	Acord Lakes
299	459887	4305917	20040527	Raven	Cliff	inactive				.	inactive	Inactive	Not Found	Not Found	Not Survey	Inactive		SUFCO	Acord Lakes
300	461017	4306414	20040527	Golden Eagle	Cliff	active			2	7	tended	Inactive	Active	Inactive	Active	Inactive	8300	SUFCO	Acord Lakes
301	461331	4307772	20040527	Raven	Cliff	inactive				.	inactive	Not Surveyed	Inactive	Inactive	Inactive	Active	8300	SUFCO	Acord Lakes
302	467080	4306340	20040527	Peregrine Falco	Cliff	inactive				This nest was previously a Prairie Falcon Eyrie. T	active	Active	Active	Active	Not Found	Tended		SUFCO	Acord Lakes
303	464834	4306717	20040527	Golden Eagle	Cliff	unknown				no details, 2 nests together	inactive	Inactive	Inactive	Inactive	Inactive	Inactive		SUFCO	Acord Lakes
304	464892	4306667	20040527	Golden Eagle	Cliff	unknown				no details, 2 nests together	inactive	Inactive	Inactive	Tended	Inactive	Tended	7700	SUFCO	Acord Lakes
305	464926	4306543	20040527	Golden Eagle	Cliff	inactive				.	inactive	Inactive	Inactive	Tended	Inactive	Inactive		SUFCO	Acord Lakes
306	464949	4306479	20040527	Golden Eagle	Cliff	inactive				2 nests together	inactive	Not Surveyed	Inactive	Inactive	Inactive	Inactive		SUFCO	Acord Lakes
307	464787	4306645	20040527	Golden Eagle	Cliff	unknown				no details	inactive	Inactive	Inactive	Inactive	Inactive	Active	7650	SUFCO	Acord Lakes
308	464696	4306468	20040527	Golden Eagle	Cliff	inactive				.	inactive	Inactive	Inactive	Active	Inactive	Inactive		SUFCO	Acord Lakes
309	464179	4306530	20040527	Raven	Cliff	unknown				.	inactive	Not Surveyed	Not Found	Not Found	Not Survey	Active		SUFCO	Acord Lakes
310	467338	4307178		Golden Eagle	Cliff	not surveye				.	inactive	Not Surveyed	Not Surveyed	Not Found	Inactive	Active		SUFCO	Acord Lakes
311	467414	4307068		Golden Eagle	Cliff	not surveye				.	not found	Not Surveyed	Not Surveyed	Tended	Inactive	Tended		SUFCO	Acord Lakes
312	467491	4307845		Golden Eagle	Cliff	not surveye				.	not surveye	Not Surveyed	Not Surveyed	Dilapidated	Not Found	Dilapidated		SUFCO	Acord Lakes
313	469783	4309324		Prairie Falcon	Cliff	not surveye				.	not found	Not Surveyed	Not Surveyed	Inactive	Active	Active		SUFCO	Emery West
314	469911	4309411		Golden Eagle	Cliff	not surveye				.	not found	Not Surveyed	Not Surveyed	Not Found	Not Found	Tended		SUFCO	Emery West
315	468910	4311684		Golden Eagle	Cliff	not surveye				.	inactive	Inactive	Inactive	Inactive	Not Survey	Inactive	8550	SUFCO	Emery West
317	466125	4311687		Red-tailed Hawk	Cliff	not surveye				.	not surveye	Inactive	Not Surveyed	Inactive	Not Survey	Active		SUFCO	Acord Lakes
318	464715	4312990		Red-tailed Hawk	Cliff	not surveye				.	not surveye	Active	Not Surveyed	Active	Inactive	Inactive		SUFCO	Acord Lakes
319	466372	4313957		Golden Eagle	Cliff	not surveye				.	not surveye	Inactive	Inactive	Tended	Inactive	Active	8100	SUFCO	Acord Lakes
320	466298	4313889		Golden Eagle	Cliff	not surveye				.	not surveye	Inactive	Inactive	Inactive	Inactive	Tended	8100	SUFCO	Acord Lakes
321	470816	4311470	20040527	Golden Eagle	Cliff	inactive				Just south of point way down low.	Dilapidated	Dilapidated	Inactive	Inactive	Inactive	Tended	8650	SUFCO	Emery West
322	474766	4312160		Golden Eagle	Cliff	not surveye				.	not surveye	Not Surveyed	Not Surveyed	Not Surveye	Not Survey	Dilapidated		SUFCO	Emery West
323	469864	4318214	20040527	Golden Eagle	Cliff	inactive				.	not surveye	Inactive	Tended	Inactive	Tended	Inactive	8100	SUFCO	Flagstaff Peak
324	471432	4320761	20040527	Prairie Falcon	Cliff	inactive				.	inactive	Inactive	Inactive	Tended	Inactive	Tended	8200	SUFCO	Flagstaff Peak
325	471762	4320762	20040527	Golden Eagle	Cliff	dilapidated				rock on top of nest	inactive	Dilapidated	Inactive	Tended	Dilapidated	Dilapidated	8200	SUFCO	Flagstaff Peak
326	475652	4312342		Golden Eagle	Cliff	not surveye				.	not surveye	Not Surveyed	Inactive	Not Surveye	Not Survey	Inactive	8000	SUFCO	Emery West
327	475310	4312186		Golden Eagle	Cliff	not surveye				.	not surveye	Not Surveyed	Dilapidated	Not Surveye	Inactive	Inactive		SUFCO	Emery West
328	474064	4311123		Golden Eagle	Cliff	not surveye				One right above the other one, high on cliff (328	inactive	Inactive	Inactive	Not Surveye	Not Survey	Inactive	8000	SUFCO	Emery West
329	474486	4311136		Golden Eagle	Cliff	not surveye				.	inactive	Inactive	Inactive	Inactive	Inactive	Inactive	8000	SUFCO	Emery West
330	471215	4309117		Golden Eagle	Cliff	not surveye				.	inactive	Inactive	Not Surveyed	Active	Inactive	Inactive		SUFCO	Emery West
331	470438	4308508		Golden Eagle	Cliff	not surveye				poor condition, little material left	inactive	Inactive	Not Surveyed	Dilapidated	Inactive	Dilapidated		SUFCO	Emery West
332	477803	4313680		Golden Eagle	Cliff	not surveye				.	not surveye	Not Surveyed	Not Surveyed	Not Surveye	Not Survey	Inactive		SUFCO	Emery West
333	477991	4314912		Golden Eagle	Cliff	not surveye				.	not surveye	Not Surveyed	Not Surveyed	Not Surveye	Not Survey	Inactive		SUFCO	Emery West
334	474544	4317566	20040527	Golden Eagle	Cliff	inactive				.	inactive	Not Surveyed	Inactive	Inactive	Dilapidated	Inactive	7600	SUFCO	Flagstaff Peak
335	473086	4318676	20040527	Golden Eagle	Cliff	inactive				.	inactive	Not Surveyed	Inactive	Inactive	Inactive	Inactive	7500	SUFCO	Flagstaff Peak
336	468976	4320806	20040527	Golden Eagle	Cliff	inactive				greenry	tended	Inactive	Inactive	Not Surveye	Not Survey	Inactive	8000	SUFCO	Flagstaff Peak
337	468102	4319756		Red-tailed Hawk	Cliff	not surveye				unknown	inactive	Inactive	Tended	Not Surveye	Not Survey	Tended	8150	SUFCO	Flagstaff Peak
338	469337	4321306	20040527	Golden Eagle	Cliff	inactive				.	not surveye	Tended	Inactive	Not Surveye	Not Survey	Inactive	8200	SUFCO	Flagstaff Peak
339	475128	4318472	20040527	Golden Eagle	Cliff	inactive				.	not surveye	Not Surveyed	Tended	Active	Active	Inactive		SUFCO	Flagstaff Peak
784	471026	4304001	20040527	Golden Eagle	Cliff	inactive				.	inactive	Inactive	Not Surveyed	Inactive	Active	NA		SUFCO	Emery West
785	471364	4304259	20040527	Golden Eagle	Cliff	inactive				.	inactive	Inactive	Not Surveyed	Active	Inactive	NA		SUFCO	Emery West
786	464965	4305581	20040527	Golden Eagle	Cliff	inactive				.	inactive	Inactive	Tended	Inactive	Inactive	NA		SUFCO	Acord Lakes
787	464965	4305581	20040527	Golden Eagle	Cliff	inactive				.	inactive	Inactive	Inactive	Inactive	Inactive	NA	7700	SUFCO	Acord Lakes
788	461975	4306435	20040527	Golden Eagle	Cliff	tended				.	tended	Dilapidated	Tended	Active	Dilapidated	NA	8300	SUFCO	Acord Lakes
791	465977	4313624		Red-tailed Hawk	Cliff	not surveye				.	not surveye	Tended	Tended	Inactive	Active	NA	8300	SUFCO	Acord Lakes
792	465810	4314285		Prairie Falcon	Cliff	not surveye				.	not surveye	Not Found	Not Found	Not Found	Not Found	NA	8100	SUFCO	Acord Lakes
793	468342	4311247		Golden Eagle	Cliff	not surveye				Low on cliff, 200 yds back from mound.	inactive	Inactive	Inactive	Dilapidated	Inactive	NA	8300	SUFCO	Emery West
794	468559	4311549		Golden Eagle	Cliff	not surveye				.	inactive	Inactive	Inactive	Tended	Tended	NA	8550	SUFCO	Emery West
795	468585	4311566		Golden Eagle	Cliff	not surveye				.	not surveye	Inactive	Inactive	Inactive	Inactive	NA	8400	SUFCO	Emery West
796	467392	4307114		Golden Eagle	Cliff	not surveye				greenry	tended	Not Surveyed	Not Surveyed	Not Found	Inactive	NA		SUFCO	Acord Lakes
797	467368	4307290		Golden Eagle	Cliff	not surveye				.	not found	Not Surveyed	Not Surveyed	Active	Dilapidated	NA		SUFCO	Acord Lakes
798	469429	4308657		Golden Eagle	Cliff	not surveye				nest in poor condition	inactive	Not Surveyed	Not Surveyed	Inactive	Active	NA		SUFCO	Emery West
801	475220	4312585		Golden Eagle	Cliff	not surveye				.	not surveye	Not Surveyed	Not Surveyed	Not Surveye	Not Found	NA		SUFCO	Emery West
802	476550	4313450		Golden Eagle	Cliff	not surveye				.	not surveye	Not Surveyed	Not Found	Not Surveye	Not Found	NA		SUFCO	Emery West
803	475723	4312328		Golden Eagle	Cliff	not surveye				20 yds over top of 326	not surveye	Not Surveyed	Inactive	Not Surveye	Inactive	NA		SUFCO	Emery West
804	475345	4312174		Golden Eagle	Cliff	not surveye				.	not surveye	Not Surveyed	Tended	Not Surveye	Tended	NA	8000	SUFCO	Emery West
805	474102	4311108		Golden Eagle	Cliff	not surveye				.	inactive	Inactive	Inactive	Inactive	Inactive	NA		SUFCO	Emery West
806	475210	4313525	20040527	Red-tailed Hawk	Cliff	not found				.	not surveye	Not Surveyed	Not Surveyed	Not Surveye	Inactive	NA		SUFCO	Emery West
807	476190	4315425	20040527	Red-tailed Hawk	Cliff	not found				.	not surveye	Not Surveyed	Not Surveyed	Not Surveye	Not Found	NA		SUFCO	Emery West
808	474749	4316823	20040527	Golden Eagle	Cliff	inactive				.	inactive	Not Surveyed	Not Surveyed	Inactive	Inactive	NA		SUFCO	Flagstaff Peak
809	474355	4317589	20040527	Golden Eagle	Cliff	inactive				.	inactive	Not Surveyed	Not Found	Not Found	Dilapidated	NA	7600	SUFCO	Flagstaff Peak
810	473985	4315198	20040527	Golden Eagle	Cliff	inactive				.	not surveye	Not Surveyed	Not Surveyed	Not Found	Not Found	NA		SUFCO	Emery West
811	473735	4315660	20040527	Golden Eagle	Cliff	inactive				.	not surveye	Not Surveyed	Not Surveyed	Not Found	Not Found	NA		SUFCO	Emery West
812	469610	4317900	20040527	Golden Eagle	Cliff	inactive				USFS PE not found	inactive	Not Found	Not Found	Inactive	Not Found	NA	8100	SUFCO	Flagstaff Peak
813	470094	4318373	20040527	Golden Eagle	Cliff	inactive				.	inactive	Inactive	Inactive	Inactive	Inactive	NA	8350	SUFCO	Flagstaff Peak
814	474900	4318300		Golden Eagle	Cliff	not surveye				.	inactive	Not Surveyed	Not Surveyed	Not Found	Not Found	NA		SUFCO	Flagstaff Peak

815	475233	4318901	20040527	Golden Eagle	Cliff	inactive	.	not surveye	Not Surveyed	Not Surveyed	Inactive	Inactive	NA		SUFCO	Flagstaff Peak
966	469555	4300386		Golden Eagle	Cliff	not surveye	.	inactive	Inactive	Inactive	Tended	NA	NA	6850	SUFCO	Walker Flat
967	469464	4300651		Golden Eagle	Cliff	not surveye	.	inactive	Inactive	Active	Tended	NA	NA		SUFCO	Walker Flat
968	469823	4298594		American Kestre	Cliff	not surveye	.	not surveye	Not Surveyed	Not Surveyed	Active	NA	NA		SUFCO	Walker Flat
969	468446	4300253		Great Horned Ow	Cliff	not surveye	.	not surveye	Not Surveyed	Not Surveyed	Active	NA	NA		SUFCO	Walker Flat
970	465747	4313249		Prairie Falcon	Cliff	not surveye	.	not surveye	Inactive	Active	Active	NA	NA	8300	SUFCO	Acord Lakes
971	465672	4314668		Red-tailed Hawk	Cliff	not surveye	.	not surveye	Inactive	Inactive	Inactive	NA	NA	8250	SUFCO	Acord Lakes
1231	464970	4305437	20040527	Golden Eagle	Cliff	inactive	2001: In narrow horizontal crack with little mater	inactive	Inactive	Active	NA	NA	NA	7500	SUFCO	Acord Lakes
1232	465241	4304168		Golden Eagle	Cliff	not surveye	.	inactive	Inactive	Inactive	NA	NA	NA	7800	SUFCO	Acord Lakes
1233	465713	4304691		Golden Eagle	Cliff	not surveye	South side of stand alone pillar.	inactive	Inactive	Inactive	NA	NA	NA	7700	SUFCO	Acord Lakes
1234	474063	4311115		Peregrine Falco	Cliff	not surveye	Just above old GE #328 nest.	inactive	Inactive	Active	NA	NA	NA	8100	SUFCO	EmeryWest
1235	470300	4318583	20040527	Golden Eagle	Cliff	inactive		inactive	Tended	Tended	NA	NA	NA	8300	SUFCO	Flagstaff Peak
1293	467310	4322070	20040527	Golden Eagle	Cliff	unknown	Fresh whitewash Peregrine falcon general area	tended	Inactive	NA	NA	NA	NA	7800	SUFCO	Heliotrope Mtn
1294	467591	4323029		Golden Eagle	Cliff	not surveye	.	inactive	Inactive	NA	NA	NA	NA	7800	SUFCO	Flagstaff Peak
1378	464460	4307872		Red-tailed Hawk	Cliff	not surveye		inactive	NA	NA	NA	NA	NA		SUFCO	ACORD LAKES
1379	470915	4309084		Golden Eagle	Cliff	not surveye		tended	NA	NA	NA	NA	NA		SUFCO	EMERY WEST
1465	467522	4322349	20040527	Golden Eagle	Cliff	tended	greenry	NA	NA	NA	NA	NA	NA		SUFCO	

Riparian Plant Communities
in the
East Fork of Box Canyon
- July 2004 -



A Vegetation Monitoring Study for the SUFCO Mine: July 2004

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SCOPE

Quantitative and qualitative baseline vegetation data were recorded in several locations in the East Fork of Box Canyon in July 2004. Additionally, data were also recorded in several locations in the Main Fork of Box Canyon; these sites may be used for controls to the study.

Coal mining activities were scheduled and conducted under the East Fork of Box Canyon during the winter of 2003-04. This document provides the *second* sample period of baseline data for the existing riparian plant communities in the two forks of Box Canyon. The *first* sample period was in the October 2003, prior to the mining activities below the East Fork (this final report was called *Riparian Plant Communities in the East Fork of Box Canyon*; the report date was March 2004).

INTRODUCTION

As described in the earlier report, the Box Canyons and their drainages are located at the southern end of the Wasatch Plateau which is a subprovince of the Colorado Plateau Physiographic Province. This area is west of the town of Emery, Utah in Sevier County and is located within the Manti-LaSal National Forest. The Box Canyon drainages are tributaries to Muddy Creek which runs into the Dirty Devil River and ultimately drains into the Colorado River. Geology of the study areas were within the Cretaceous strata of the Mesa Verde Group. The upper portions of the study area were comprised of rocks and soils derived from the cliff-forming Castlegate Sandstone. The lower reaches of the study area encounters shales of the Blackhawk Formation. Elevation of the study area was between 8,000 ft to 8,500 ft above sea level.

This study concentrated on the riparian plant communities within the East Fork of Box Canyon because underground mining had been proposed in this area. However, because no mining was planned underneath the Main Fork of Box Canyon, some control transects were also placed in this drainage.

A variety of biological and other resource information can be studied to evaluate and characterize riparian complexes including vegetation, geology, channel morphology, aquatic biology, soils, and stream flow. The primary focus of this study was on the vegetation as to provide baseline and followup information by monitoring the riparian communities in the East Fork of Box Canyon. Regular monitoring should provide data to determine long term trends, natural variability and benchmark information including the possible impacts on the riparian plant communities from mining beneath the creek.

Like the 2003 study, this study primarily employed vegetation monitoring methods described by the USDA Forest Service for a "Level III Riparian Area Evaluation". The design of this study will not provide data that could show subtle changes to community structure and species composition as a result of *minor* changes to the riparian habitat. Rather, the study was designed to be compared with earlier (and future) studies in an attempt to document *major* impacts to the plant communities along the stream due to catastrophic events, such as loss of water and habitat

from the effects of subsidence caused from underground mining. (**Note**: **On the data sheets in the aforementioned study, a typographical error indicated that the data were recorded from October 6-10, 2004. The dates should have been recorded as October 6-10, 2003**).

METHODS

Sample station locations were pre-determined from an earlier field visit in 2003 by a team of specialists and representatives from the State of Utah, Division of Oil, Gas & Mining (DOGM), Canyon Fuel Company (CFC), USDA Forest Service (USFS), Mt. Nebo Scientific, Inc. and other consultants. These stations were placed in areas with the intent to provide similar study areas where data could be recorded in several disciplines including biology, hydrology and geology. These sample stations were called "team stations" in this report.

The vegetation monitoring methods of the study was principally based on those described by the USDA Forest Service for a *"Level III Riparian Area Evaluation*" (Integrated Riparian Evaluation Guide, March 1992), but does expand on those methodologies.

Qualitative and quantitative data were recorded at each sample location. Although some maintenance may be required, locations and extent of the line transects were permanently marked using numbered and flagged wooden stakes and 12-inch metal nails. Photographic stations for documentation and future comparisons were established at each sample location.

In this report, when reference is made to the left or right side of the drainage, this means "river left" or "river right", *as characterized by looking downstream*.

RIPARIAN COMPLEX DATA SHEET

CLIENT:
COMPLEX: Riverine - Number
WATERBODY NAME:
LOCATION:
DATE:
OBSERVER(S):
QUAD NAME:
GEOLOGIC PARENT MATERIAL:
ASPECT:
VALLEY BOTTOM TYPE:
STREAM GRADIENT:
ELEVATION: .
SIZE OF COMPLEX:
SOILS INFORMATION:
ADJACENT UPLAND VEGETATION (looking downstream)
Left: Right:
VEGETATIVE DESCRIPTION (Dominance by Community Types)
SUCCESSIONAL STATUS:
APPARENT FORAGE TREND:
ESTIMATED FORAGE PRODUCTION:
BEAVER ACTIVITY:
PHOTOGRAPH TAKEN: (from right side unless otherwise stated)
LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA:
SPECIES OBSERVED:
POOL ATTRIBUTES
- % area in pools:
- % pool area made up of pools > 2' deep:

AQUATIC VEGETATION
- % streambed with filamentous algae:
- % stream margin with rooted aquatic:

BANK TYPE & VEGETATION OVERHANG
- % bank length undercut (<90°):
- % bank length gently sloping (>135°):
- % bank length with overhanging vegetation:

BANK CONDITION (bankfull area only)
- % bank length vegetated, stable:
- % bank length unvegetated, stable:
- % bank length vegetated, unstable:
- % bank length unvegetated, unstable:

BANK STABILITY (near water line):
CHANNEL MORPHOLOGY
NOTES:

Qualitative Data

The "Riparian Complex Data Sheet" on the previous page lists all of the qualitative data (and some of the quantitative data) that were collected at all sample stations.

Quantitative Data

As mentioned previously, USFS protocol was utilized for the study. However, to increase the level of detail, some modifications to this protocol were employed to those sample areas chosen by the team specialists (team stations). The primary reason for the modifications were twofold. First, it will provide more diverse data sets, or other ways to measure potential changes to the vegetation in the canyons. Second, there is an existing baseline data set that was recorded in 1999 for the riparian communities in the two Box Canyons. With only a couple of exceptions, the sample areas in the 1999 data set were different than the team stations of the subsequent studies. Although data were recorded in 2003 and 2004 at some of the same sample locations as were used in 1999, in an attempt to maintain standardized data sets, the modifications to the protocol were not made at these stations. Some of the 1999 stations were located for the 2003 and 2004 studies so that, if necessary, they may provide worthwhile information through time that otherwise would not have been available with one baseline data set. (*One note of caution, however, is that the 1999 and 2003-04 data sets were not designed specifically to be compared – there may be some issues or problems associated with these comparisons*).

With the one exception to the protocol modification mentioned above, the parameters for all sample stations in the 2003 and 2004 studies were identical. The modification to the USFS protocol was in the methods that cover data were recorded. Depending on the site, three different methods were employed to measure cover. They are explained below.

Total Cover

For all the team stations, "total cover" was recorded. First, transect lines were established perpendicular to the stream channel. With a few exceptions such as constraints imposed by rock ledges or other topographical features, the transect line lengths were consistent, or 24 ft. on each side of the stream. The length of the transect lines extended far enough upslope to insure that they also included upland vegetation types (usually 3 quadrats on each side) as well as the riparian vegetation being sampled. The transect lines on each side of the stream began at the bottomland near the edge of the water, or where the riparian vegetation began. In some cases, no water was present at a given sample site. In those instances, the transect lines began where the water would normally be present (i.e. sandy or rock bottom). Water or dry channel widths were measured and added to the total length of the transects.

Regular points were placed at 3 ft. intervals on the transect lines. At these points, point quadrats

were used to record the total cover. Cover by these "hits" could include the plant species, moss, litter, bareground or rock. Therefore, total cover when the data were summarized, included 1) percent of the living cover of each plant species, 2) total living cover (vascular), 3) total living cover (nonvascular), 4) litter cover, 5) bareground cover, and 6) rock cover.

Community Type Cover

The Community Type Cover was one method to record cover in the USFS Level III protocol and was used in those additional areas that were added to the riparian study. In other words, these areas were part of the 1999 study and were added to the study **in addition to** those chosen by the team. (In a few areas, the sample locations chosen by the team and those from the 1999 study were the same – in those cases, both methods for estimating cover were employed).

At these locations permanently marked transects lines had previously been placed across (or perpendicular to) the stream channel. The line transects had varied lengths by design which were based on several factors. Although sometimes limited by topographical features such as sandstone cliffs, the intent was to make the transects long enough to cover the entire stream, its riparian communities, plus an additional 10 ft on each side of the stream to record the adjacent upland communities. Monitoring the total extent of the riparian plant communities including some upland community information should provide information about possible increases or decreases in the riparian communities relative to the adjacent upland communities.

Once the transect was placed, the line-intercept method was employed measuring the extent of each major riparian plant community. The plant communities were named by the dominant two plant species. If only one species dominated the community by a wide margin, the plant community was named by this single species. In this method, cover by each plant species is not calculated.

Green Line Cover

In addition to the methods for estimating cover described above, "Green Line" cover was also recorded at *all sample locations*. This method consisted of using a tape to measure the riparian community (Green Line) on each side of the stream. Similar to the Community Type cover described above, the dominant one or two species were listed with each measurement. Results from the Green Line method is similar to the Community Type method in that it quantifies the extent of the riparian community of each sample site. Differences are that the Green Line method separates the riparian data for each side of the stream, whereas the Community Type method provides total cover including: riparian community types, upland community types, bareground, litter, rock and stream.

Site Numbers

The sample sites that were pre-determined by the team of specialists (team stations) that will be

used for studies other than those for this report were numbered accordingly and will be consistent with those other studies (geology and hydrology). However, those additional sites that were chosen to supplement the data sets, or the subset of riparian sites that were sampled in 1999, were numbered to be consistent with those sample sites. In some cases, they are the same location. A summary to clarify the numbered sites and the cover sampling method used at each site is shown in the RESULTS section below.

RESULTS

Listed below is a summary of the sample locations, site numbers and protocol used.

Sample Site Number	Other Name or Number	USFS Level III Protocol	Cover Protocol: Green Line	Cover Protocol: Point Quadrat	Cover Protocol: Community Type
EFB-1		X	X	X	
EFB-2		X	X	X	
EFB-3		X	X	X	
EFB-4		X	X	X	
EFB-5		X	X	X	
EFB-6		X	X	X	
EFB-7		X	X	X	
EFB-8		X	X	X	
EFB-9	RE-10	X	X	X	X
EFB-10	RE-09	X	X	X	X
EFB-11		X	X	X	
EFB-S1*		X	X		X
EFB-S2*	EFB-12	X	X		X
EFB-S3*	EFB-13	X	X		X
EFB-S4*	EFB-14	X	X		X
RE-11		X	X		X
RE-12		X	X		X
RE-13		X	X		X
R-07		X	X		X
R-09		X	X		X
R-11		X	X		X
R-13		X	X		X
R-15		X	X		X
*S= Spring					

Sample results are shown for each site on the data sheets in this report. Each sheet shows all qualitative and quantitative data recorded as well as photographic documentation.

DISCUSSION & SUMMARY

Results from monitoring the riparian communities in the East Fork of Box Canyon have been included in this report. A summary of all qualitative and quantitative data for each sample location are shown in the following section of this report.

The USDA Forest Service protocol was employed to monitor the riparian communities. This protocol utilizes results from qualitative data of the riparian complexes such as geology, geomorphology, biology, physiognomy, soils, and channel characteristics as part of the data collection process. Quantitative data were also recorded from the riparian plant communities. The methods used to record cover data at the team stations employed the use of point quadrats to record *Total Cover*. Additional sample stations from a previous study (1999) were also added to the sampling regime in 2003 and 2004. Five of these sample stations were located in the East Fork of Box Canyon and five were in the Main Fork of Box Canyon. Methodologies to estimate cover (*Community Cover*) for the additional sites remained consistent with the earlier study in the event that some comparisons are made in the future. A method referred to as the *Green Line Method* for measuring the riparian communities was also employed at all sample locations.

When the data for October 2003 and July 2004 were compared in the East Fork of Box Canyon, the trend seems to indicate that the riparian communities have decreased somewhat. These differences were especially significant in the spring areas (EFB-S1, EFB-S2 EFB-S3 EFB-S4) where much of the water source for them seems to have decreased significantly. Some of the other riparian areas had the same trend, but one must remember that they are different sample seasons (Fall vs. Spring) and cattle use seemed to be much greater in July 2004 when compared to October 2003 (refer to data sheets of specific areas). This trend is also apparent in the Main Fork of Box Canyon, but the differences between sample periods do not seem to have been as significant. Overall cattle use also seemed to be less in this canyon when compared to the East Fork.

These results show some trends, but they are preliminary. Future studies should provide a more clear picture of whether or not the riparian complexes are changing.

RIPARIAN COMPLEX DATA SHEET
July 2004

CLIENT: Canyon Fuel Company

COMPLEX: Number EFB-1

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 20 - 24, 2004

OBSERVER(S): P.D. Collins[2]

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: West

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~1°

ELEVATION: 8,410ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Aspen Right: Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data results for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: moderately stable

ESTIMATED FORAGE PRODUCTION: 1300 lbs./acre

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Salix sp.*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides	*Potentilla fruticosa*		*Carex lanuginosa*
	Rosa woodsii		*Juncus ensifolius*
			Juncus arcticus
			Poa pratensis

POOL ATTRIBUTES (meadow, no well defined stream channel)

% area in pools: 0

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 0

% bank length with overhanging vegetation: 40

BANK CONDITION

% bank length vegetated, stable: 90

% bank length unvegetated, stable: 10

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many of the sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) This was a meadow area, not a stream. No surface water (muddy).
2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 27 ft. transect on left side; 33 ft. transect on right side (total 60 ft). Green Line: Also measured on these transects.
3) A place where cattle congregated. A dam was created to hold water.

DATA SUMMARIES

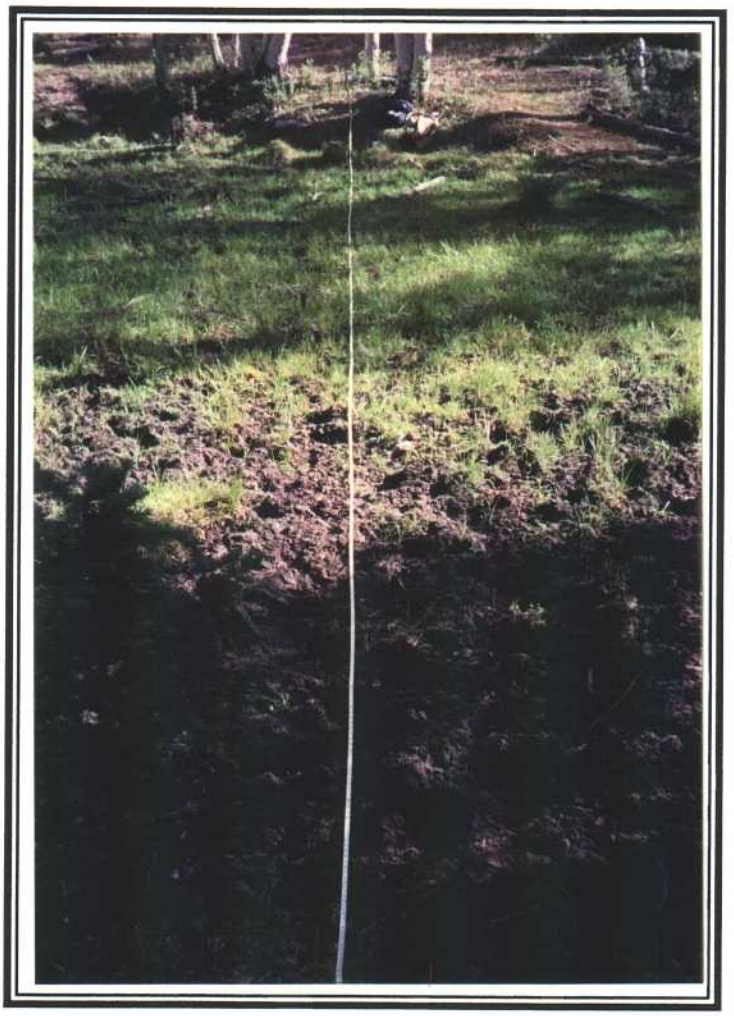
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-1		Left	24.0	*Carex lanuginosa/Agrostis stolonifera*
		Right	29.0	*Carex lanuginosa/Agrostis stolonifera*
		Channel	n/a	

EFB-1: Cover using point quadrats (July 2004).

COVER BY SPECIES	Percent
TREES & SHRUBS	
FORBS	
GRASSES OR GRASS-LIKES	
Agrostis stolonifera	21.05
Carex lanuginosa	15.79
TOTAL COVER	
LIVING COVER (vascular)	36.84
WATER	0.00
MOSS	0.00
LITTER	26.32
BAREGROUND	36.84
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-1

RIPARIAN COMPLEX DATA SHEET
July 2004

CLIENT: Canyon Fuel Company

COMPLEX: Number EFB-2

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 20- 24, 2004

OBSERVER(S): P.D. Collins[2]

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: WNW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~1-2°

ELEVATION: 8,380 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen/Sagebrush Right: Aspen/Sagebrush

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 800 lbs./ac

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Pinus ponderosa	*Artemisia tridentata*	*Aster sp.*	*Juncus arcticus*
Populus tremuloides	*Potentilla fruticosa*	*Lepidium latifolium*	*Poa secunda*
		Taraxacum officinale	*Poa pratensis*

POOL ATTRIBUTES (meadow, no well defined stream channel)

% area in pools: 0

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 0

% bank length with overhanging vegetation: 0

BANK CONDITION

% bank length vegetated, stable: 85

% bank length unvegetated, stable: 15

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many of the sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) This was a meadow area, not a stream.
2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side. Green Line: Also measured on these transects.
3) The was a lot of impact to area by cattle.
4) Meadow area; dry. Site was in fair condition.
5) Due to dryness and upland vegetation, it was difficult to decide what to call the "Green Line".

DATA SUMMARIES

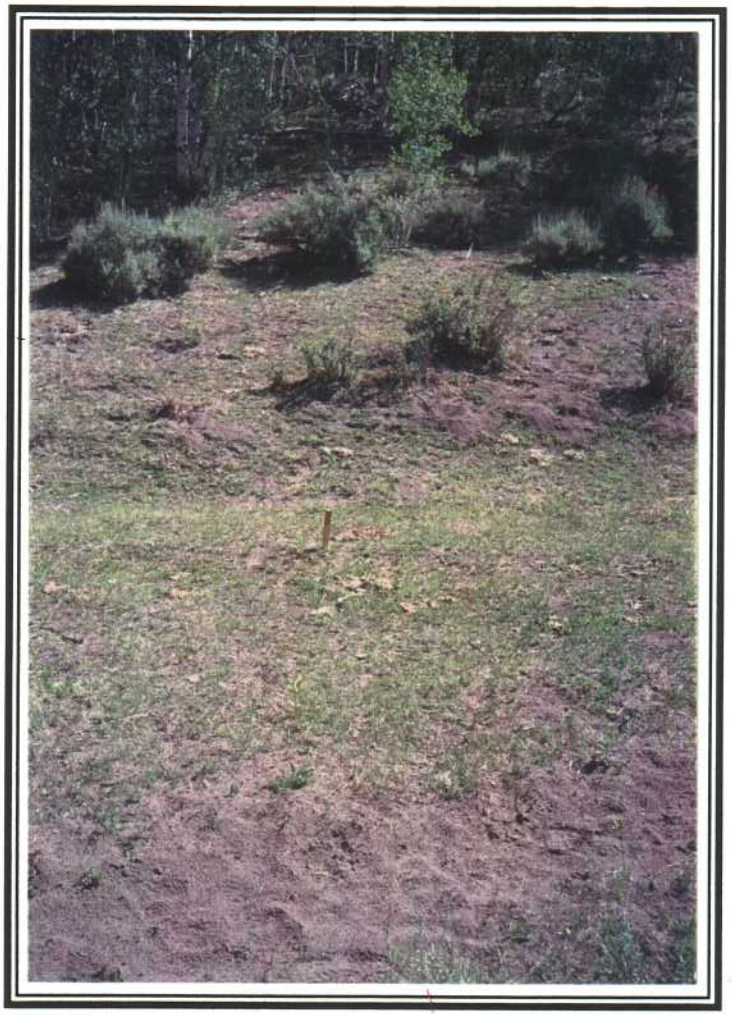
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-2		Left	12.0	*Agrostis stolonifera/Poa pratensis*
		Right	12.0	*Agrostis stolonifera/Poa pratensis*
		Channel	n/a	

EFB-2: Cover using point quadrats (July 2004).

COVER BY SPECIES	Percent
TREES & SHRUBS	
FORBS	
Campanula parryi	6.25
Erigeron divergens	6.25
GRASSES OR GRASS-LIKES	
Agrostis stolonifera	12.50
Carex lanuginosa	6.25
Juncus longistylis	6.25
TOTAL COVER	
LIVING COVER (vascular)	37.50
WATER	0.00
MOSS	0.00
LITTER	25.00
BAREGROUND	37.50
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-2

RIPARIAN COMPLEX DATA SHEET
July 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-3

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 20 - 24, 2004

OBSERVER(S): P.D. Collins[2]

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: NW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,360 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen Right: Aspen/Ponderosa Pine

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 600 lbs./ac

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Pinus ponderosa	*Artemisia tridentata*	*Equisetum arvense*	*Agrostis stolonifera*
Populus tremuloides		*Lepidium latifolia*	*Carex lanuginosa*
		Lupinus sp.	*Juncus ensifolius*
		Taraxacum officinale	*Juncus arcticus*
			Poa fendleriana

POOL ATTRIBUTES

% area in pools: n/a (no water in the channel at this location)
% pool area made up of pools > 2' deep: n/a (no water in the channel at this location)

AQUATIC VEGETATION

% streambed with filamentous algae: n/a (no water in the channel at this location)
% stream margin with rooted aquatic: n/a (no water in the channel at this location)

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0
% bank length gently sloping (>135°): 20
% bank length with overhanging vegetation: 10

BANK CONDITION

% bank length vegetated, stable: 95
% bank length unvegetated, stable: 5
% bank length vegetated, unstable: 0
% bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side. (1 ft. bare stream area). Green Line: Also measured on these transects.
2) Lots of cattle use here; probably relatively more bareground present (see quant. data). There was a cattle trail right through the "Green Line".
3) The bottom of stream was stable; the upper side slopes were unstable (like most of the canyon).
4) Dry, no stream water present.

DATA SUMMARIES

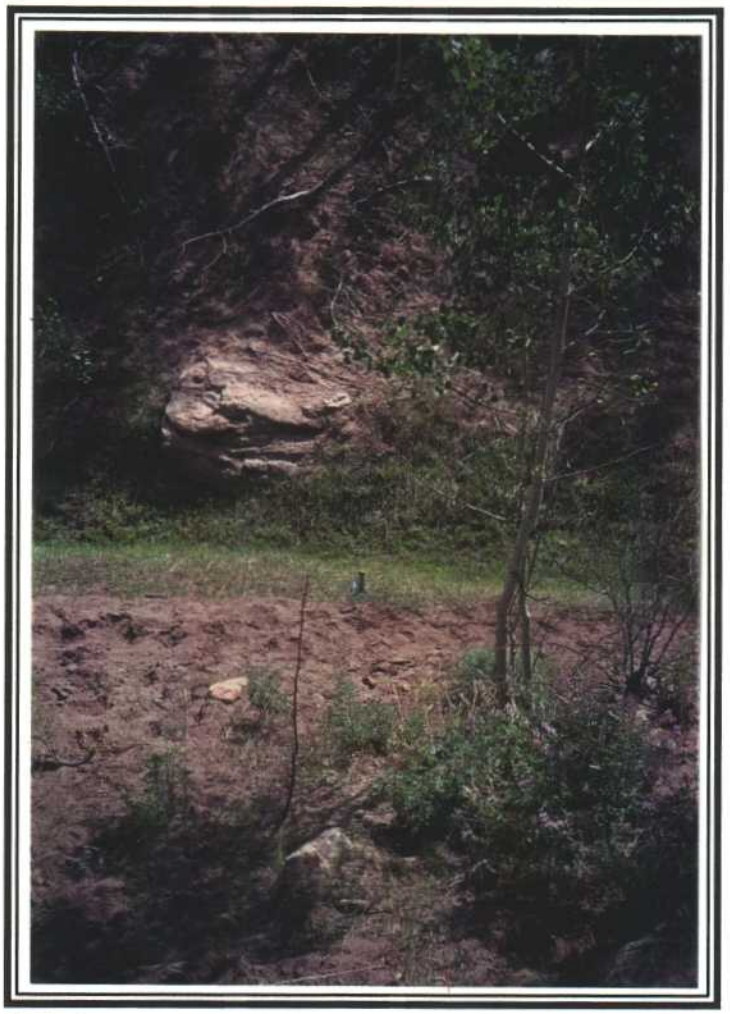
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-3		Left	4.5	*Agrostis stolonifera/Juncus arcticus*
		Right	3.5	*Agrostis stolonifera/Juncus arcticus*
		Channel	1.0	Dry

EFB-3: Cover using point quadrats (July 2004).

COVER BY SPECIES	Percent
TREES & SHRUBS	
FORBS	
GRASSES OR GRASS-LIKES	
Agrostis stolonifera	12.50
Carex nebraskensis	6.25
Juncus articus	6.25
TOTAL COVER	
LIVING COVER (vascular)	25.00
WATER	0.00
MOSS	0.00
LITTER	12.50
BAREGROUND	56.25
ROCK	6.25
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-3

RIPARIAN COMPLEX DATA SHEET
July 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-4

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 20 - 24, 2004

OBSERVER(S): P.D. Collins[2]

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~3°

ELEVATION: 8,355 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Ponderosa Pine/Aspen Right: Aspen/Ponderosa Pine

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 400 lbs./ac

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Artemisia tridentata*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides	*Chrysothamnus nauseosus*	*Antennaria sp.*	*Carex lanuginosa*
Pinus ponderosa	*Potentilla fruticosa*	*Taraxacum officinale*	*Bromus carinatus*
Salix sp.	*Rosa woodsii*		*Juncus arcticus*
			Poa fendleriana

POOL ATTRIBUTES

% area in pools: 65

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 0

% bank length with overhanging vegetation: 5

BANK CONDITION

% bank length vegetated, stable: 50

% bank length unvegetated, stable: 30

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 20

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side (1 ft. water). Green Line: Also measured on these transects.
2) Working downstream, this site was the first to have water.
3) The unstable upper bank slopes probably influenced the stream-side riparian vegetation too.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-4		Left	2.0	*Juncus arcticus/Agrostis stolonifera*
		Right	1.0	*Agrostis stolonifera/Juncus ensifolius*
		Channel	1.0	Water

EFB-4: Cover using point quadrats (July 2004).

COVER BY SPECIES	Percent
TREES & SHRUBS	
Rosa woodsii	12.50
FORBS	
Achillea millefolium	6.25
Antennaria microphylla	6.25
GRASSES OR GRASS-LIKES	
Agrostis stolonifera	6.25
Elymus trachycaulus	6.25
Juncus articus	12.50
Poa fendleriana	6.25
Juncus longistylis	6.25
TOTAL COVER	
LIVING COVER (vascular)	62.50
WATER	0.00
MOSS	6.25
LITTER	6.25
BAREGROUND	25.00
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION

EFB-4

RIPARIAN COMPLEX DATA SHEET
July 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-5

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 20 - 24, 2004

OBSERVER(S): P.D. Collins[2]

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,320 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen Right: Ponderosa Pine/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: moderately stable

ESTIMATED FORAGE PRODUCTION: 200 lbs./ac

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Artemisia tridentata*	*Tragopogon dubius*	*Agrostis stolonifera*
Populus tremuloides	*Potentilla fruticosa*	*Senecio sp.*	*Poa fendleriana*
Pinus ponderosa	*Rosa woodsii*		*Stipa hymenoides*
	Symphoricarpos oreophilus		

POOL ATTRIBUTES

% area in pools: n/a (no water in this area)
% pool area made up of pools > 2' deep: n/a (no water in this area)

AQUATIC VEGETATION

% streambed with filamentous algae: n/a (no water in this area)
% stream margin with rooted aquatic: n/a (no water in this area)

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0
% bank length gently sloping (>135°): 0
% bank length with overhanging vegetation: 5%

BANK CONDITION

% bank length vegetated, stable: 50
% bank length unvegetated, stable: 45
% bank length vegetated, unstable: 0
% bank length unvegetated, unstable: 5

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Side slopes (above bankfull) were very unstable.
2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side (1.5 ft. of dry sandy bottom). Green Line: Also measured on these transects.
3) No water in channel in this location.

DATA SUMMARIES

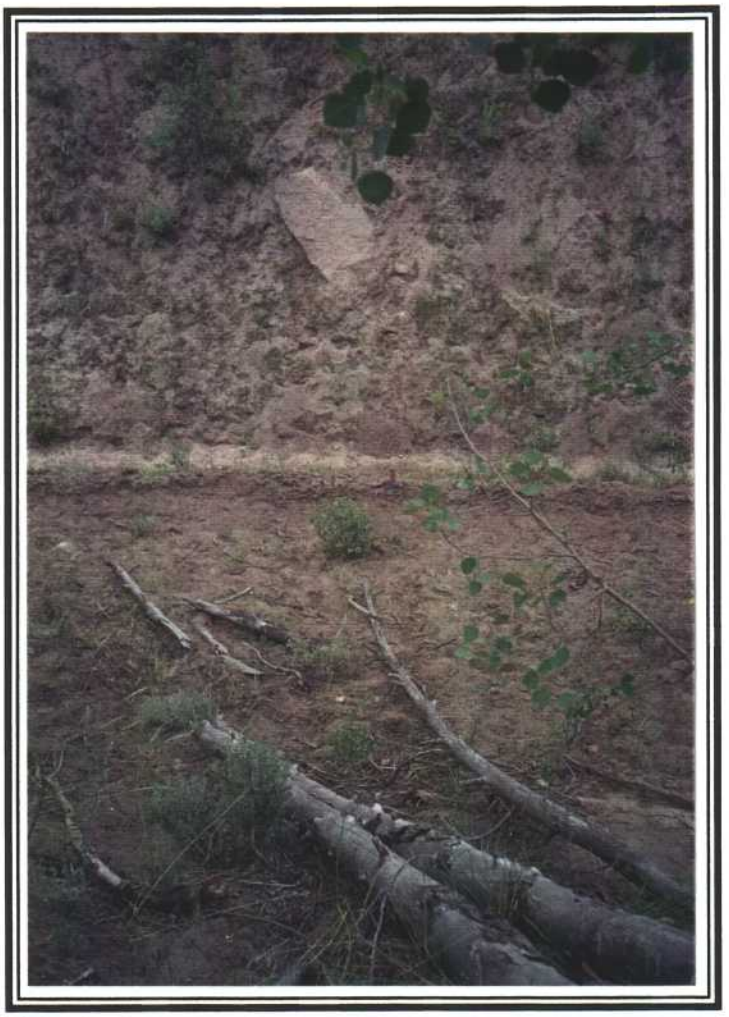
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-5		Left	2.5	Carex lanuginosa/ *Agrostis stolonifera*
		Right	2.5	*Agrostis stolonifera*
		Channel	1.5	Dry

EFB-5: Cover using point quadrats (July 2004).

COVER BY SPECIES	Percent
TREES & SHRUBS	
Populus fremontii	6.25
FORBS	
GRASSES OR GRASS-LIKES	
Agrostis stolonifera	6.25
Carex lanuginosa	6.25
Poa fendleriana	12.50
Stipa hymenoides	12.50
TOTAL COVER	
LIVING COVER (vascular)	43.75
WATER	0.00
MOSS	0.00
LITTER	25.00
BAREGROUND	25.00
ROCK	6.25
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-5

RIPARIAN COMPLEX DATA SHEET
July 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-6

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 20 - 24, 2004

OBSERVER(S): P.D. Collins[2]

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,280 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
  - Scout Family Soils: 35 %
  - Doney Family Soils: 25%
  - Guben Family Soils: 25%
  - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen/Ponderosa Pine Right: Pinus ponderosa/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status)..

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 150 lbs./ac

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Amelanchier utahensis*	*Taraxacum officinale*	*Agrostis stolonifera*
Populus tremuloides	*Potentilla fruticosa*	*Antennaria sp.*	*Bromus carinatus*
Pinus ponderosa	*Symphoricarpos oreophilus*	*Aster sp.*	*Juncus arcticus*
Populus fremontii	*Artemisia tridentata*	*Tragopogon dubius*	*Poa fendleriana*
		Senecio sp.	*Elymus trachycaulus*
		Swertia radiata	*Juncus longistylis*
		Artemisia ludoviciana	

POOL ATTRIBUTES

% area in pools: 50

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 50

% bank length gently sloping (>135°): 30

% bank length with overhanging vegetation: 10

BANK CONDITION

% bank length vegetated, stable: 40

% bank length unvegetated, stable: 10

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 50

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Side slope banks above bankfull unstable
2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side. Green Line: Also measured on these transects.
3) Cattle trail destroyed some of the riparian vegetation esp. on left side.

DATA SUMMARIES

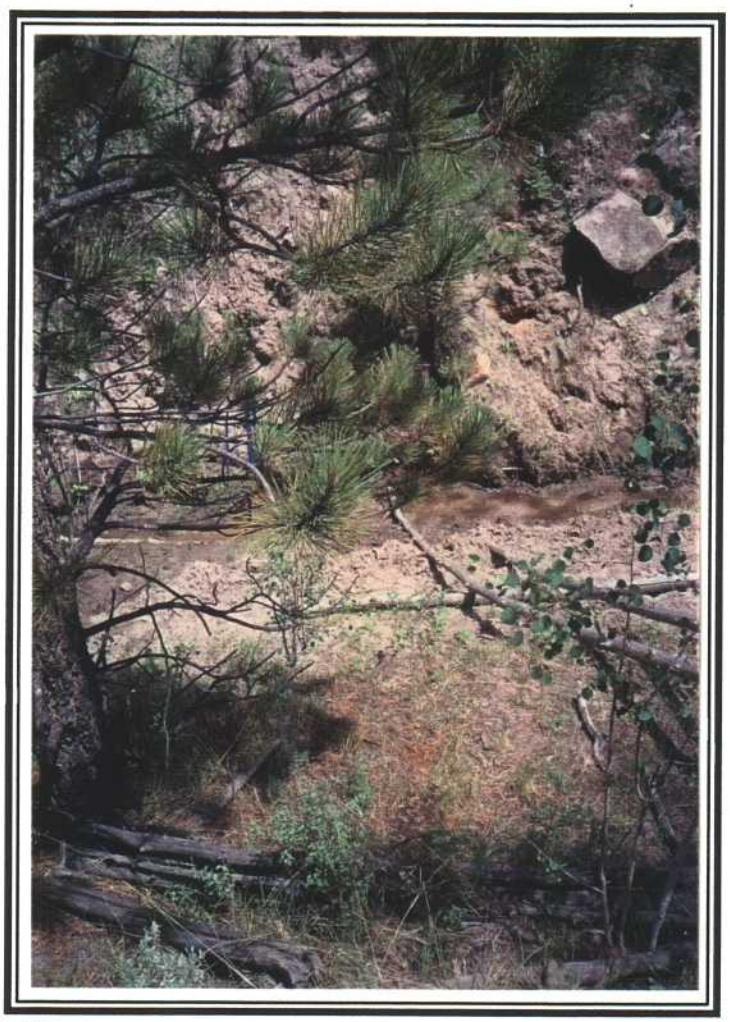
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-6		Left	1.0	*Bareground*
		Right	2.0	*Agrostis stolonifera/Ranunculus cymbalaria*
		Channel	3.0	1.0 water, 2.0 bareground

EFB-6: Cover using point quadrats (July 2004).

COVER BY SPECIES	Percent
TREES & SHRUBS	
FORBS	
Ranunculus cymbalaria	6.25
Taraxacum officinale	6.25
GRASSES OR GRASS-LIKES	
Agrostis stolonifera	6.25
Juncus articus	6.25
Poa fendleriana	18.75
TOTAL COVER	
LIVING COVER (vascular)	43.75
WATER	0.00
MOSS	0.00
LITTER	18.75
BAREGROUND	37.50
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-6

RIPARIAN COMPLEX DATA SHEET
July 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-7

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 20 - 24, 2004

OBSERVER(S): P.D. Collins[2]

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: NNW

VALLEY BOTTOM TYPE: I or II

STREAM GRADIENT: ~2°

ELEVATION: 8,270 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
  - Scout Family Soils: 35 %
  - Doney Family Soils: 25%
  - Guben Family Soils: 25%
  - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen/Spruce Right: Aspen/Spruce

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: decreasing

ESTIMATED FORAGE PRODUCTION: 50 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Juniperus communis*	*Aster sp.*	*Agrostis stolonifera*
Populus tremuloides			*Juncus longistylis*
			Poa fendleriana

POOL ATTRIBUTES

% area in pools: 30
% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0
% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0
% bank length gently sloping (>135°): 30.
% bank length with overhanging vegetation: 5

BANK CONDITION

% bank length vegetated, stable: 10
% bank length unvegetated, stable: 90
% bank length vegetated, unstable: 0
% bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Not much riparian vegetation here; riparian area was almost entirely bare.
2) Quantitative Methods:Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side (1.0 ft. water, 2.0 ft. mud). Green Line: Also measured on these transects.
3) Lots of cattle use on trail in area.

DATA SUMMARIES

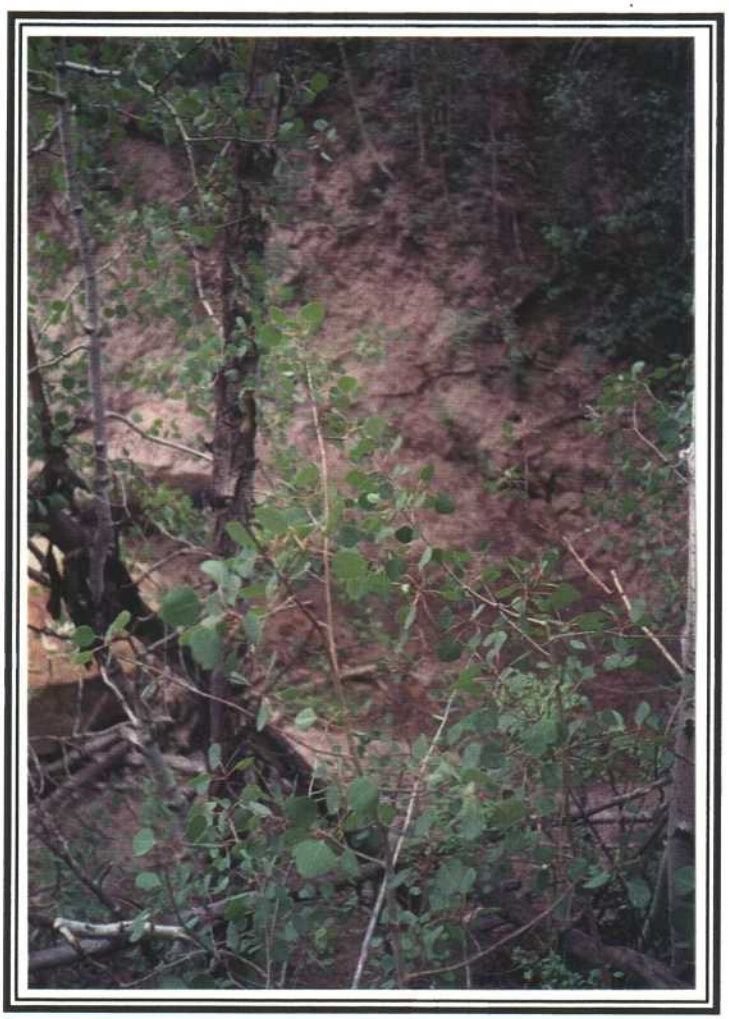
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-7		Left	1.0	*Agrostis stolonifera*
		Right	0	bareground
		Channel	3.0	1.0 water; 2.0 mud

EFB-7: Cover using point quadrats (July 2004).

COVER BY SPECIES	Percent
TREES & SHRUBS	
Populus tremuloides	12.50
FORBS	
Artemisia dracunculus	6.25
GRASSES OR GRASS-LIKES	
TOTAL COVER	
LIVING COVER (vascular)	18.75
WATER	0.00
MOSS	0.00
LITTER	43.75
BAREGROUND	37.50
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-7

RIPARIAN COMPLEX DATA SHEET
July 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-8

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 20 - 24, 2004

OBSERVER(S): P.D. Collins[2]

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: NNW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,265 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
  - Scout Family Soils: 35 %
  - Doney Family Soils: 25%
  - Guben Family Soils: 25%
  - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Aspen Right: Aspen/Spruce

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: decreasing

ESTIMATED FORAGE PRODUCTION: 200 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Symphoricarpos oreophilus*	*Geranium richardsonii*	*Agrostis stolonifera*
Populus tremuloides		*Achillea millefolium*	*Carex lanuginosa*
Pinus ponderosa		*Penstemon sp.*	*Juncus arcticus*
		Antennaria sp.	*Poa fendleriana*
		Equisetum arvensis	

POOL ATTRIBUTES

% area in pools: 10

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 30

% bank length with overhanging vegetation: 20

BANK CONDITION

% bank length vegetated, stable: 45

% bank length unvegetated, stable: 45

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 5

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Beginning to see more blue spruce and less ponderosa pine in uplands in this area.
2) Quantitative Methods: Put in one long transect line; did not differentiate data by sides. It was difficult to say where to measure because a flowing spring was next to the riparian area. Therefore the transect dissected the spring somewhat as well as the riparian area. Green Line: Also measured on these transects.
3) There was lots of impact here to the riparian community from cattle.

DATA SUMMARIES

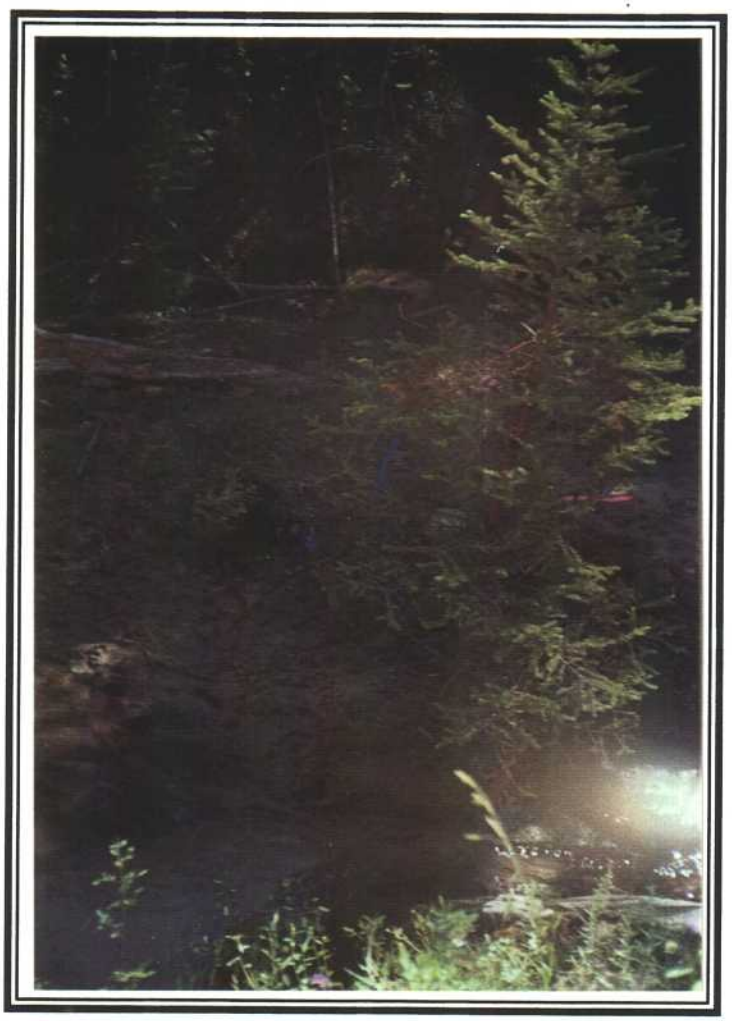
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-8		Left	1.5	*Agrostis stolonifera*
		Right	2.5	*Agrostis stolonifera/Equisetum arvense*
		Channel	9.0	4.5 water; 4.5 mud

EFB-8: Cover using point quadrats (July 2004).

COVER BY SPECIES	Percent
TREES & SHRUBS	
Rosa woodsii	5.56
FORBS	
Achillea millefolium	5.56
GRASSES OR GRASS-LIKES	
Agrostis stolonifera	11.11
Poa pratensis	11.10
LIVING COVER (vascular)	33.33
WATER	0.00
MOSS	0.00
LITTER	11.11
BAREGROUND	55.56
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-8

RIPARIAN COMPLEX DATA SHEET
July 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-9 (RE-10)

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 20 - 24, 2004

OBSERVER(S): P.D. Collins[2]

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss/Blackhawk Fm

ASPECT: W

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~3°

ELEVATION: 8,240 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
  - Scout Family Soils: 35 %
  - Doney Family Soils: 25%
  - Guben Family Soils: 25%
  - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen Right: Spruce/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: decreasing

ESTIMATED FORAGE PRODUCTION: 100

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Rosa woodsii*	*Equisetum arvensis*	*Agrostis stolonifera*
Populus tremuloides	*Symphoricarpos oreophilus*	*Geranium richardsonii*	*Poa fendleriana*
Salix amygdaloides			

POOL ATTRIBUTES

% area in pools: 20

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 20

% bank length gently sloping (>135°): 20

% bank length with overhanging vegetation: 20

BANK CONDITION

% bank length vegetated, stable: 30

% bank length unvegetated, stable: 40

% bank length vegetated, unstable: 10

% bank length unvegetated, unstable: 20

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable (left side)/unstable (right side)

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) All banks unstable.
2) Quantitative Methods: Point quadrats: Sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side. Green Line: Also measured on these transects. Line intercept: In addition, the USDA Forest Service Protocol for Level III was employed by measuring the plant communities using the line intercept method. Both transects were staked; 50 ft for pt quarter; 32 ft for line intercept.
3) Photo taken from right side.
4) Lots of sand in streambank.
5) Some cattle disturbance, but not as much as previous sample areas.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-9	RE-10	Left	5.0	*Agrostis stolonifera/Equisetum arvense*
		Right	1.0	*Agrostis stolonifera/Equisetum arvense*
		Channel	3.0	2.0 water; 1.0 mud

EFB-9: Cover using point quadrats (July 2004).

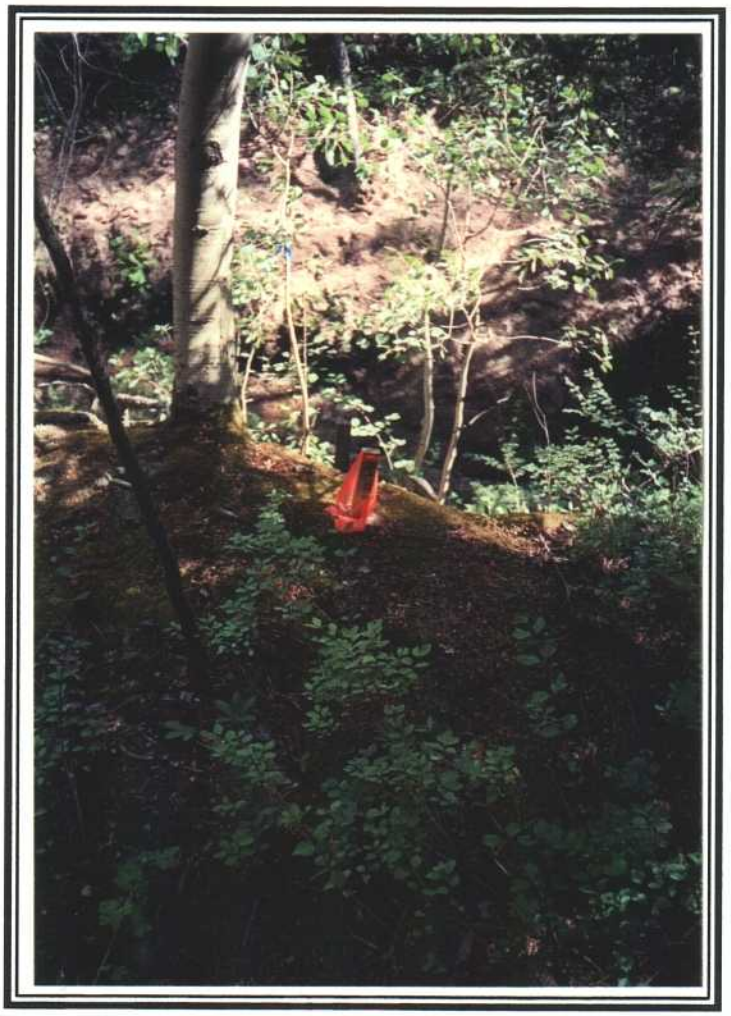
COVER BY SPECIES	Percent
TREES & SHRUBS	
Symphoricarpos oreophilus	6.25
FORBS	
Equisetum arvense	6.25
Geranium richardsonii	12.50
TOTAL COVER	
LIVING COVER (vascular)	25.00
WATER	6.25
MOSS	25.00
LITTER	18.75
BAREGROUND	25.00
ROCK	0.00
TOTAL	100.00

Cover by Community Types (July 2004) - RE-10

USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Populus tremuloides/Picea pungens	12.00
Populus tremuloides/Rosa woodsii	11.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Ranunuculus cymbalaria	3.00
Geranium richardsonii	2.00
Agrostis stolonifera/Geranium richardsonii	1.00
TOTAL COVER (Upland Species)	23.00
TOTAL COVER (Riparian Species)	6.00
BAREGROUND	0.00
ROCK	0.00
WATER/MUD	3.00
TOTAL COVER	32.00

PHOTOGRAPHIC DOCUMENTATION



EFB-9 (RE-10)

RIPARIAN COMPLEX DATA SHEET

July 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-10 (RE-09)

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 20 - 24, 2004

OBSERVER(S): P.D. Collins[2]

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Blackkhawk

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~3°

ELEVATION: 8,120 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
  - Scout Family Soils: 35 %
  - Doney Family Soils: 25%
  - Guben Family Soils: 25%
  - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

MORE SOILS INFORMATION:

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce Right: Spruce/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: decreasing

ESTIMATED FORAGE PRODUCTION: 100 lbs./ac

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Rosa woodsii*	*Epilobium angustifolium*	*Agrostis stolonifera*
Populus tremuloides		*Geranium richardsonii*	
Betula occidentalis		*Equisetum arvense*	
Pinus ponderosa			
Salix amygdaloides			

POOL ATTRIBUTES

% area in pools: 40

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 20

% bank length gently sloping (>135°): 35

% bank length with overhanging vegetation: 30

BANK CONDITION

% bank length vegetated, stable: 35

% bank length unvegetated, stable: 35

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 35

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Just beginning to see river birch in this area.
2) Quantitative Methods: Point quadrats; Oct 2003: sampled at 3 ft. intervals; 24 ft. transect on left side; 12 ft. transect on right side until rock ledge (plus 2.5 ft. of water). July 2004: sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side(plus 2.0 ft. of water). Green Line: Also measured on these transects.
   In addition, the USDA Forest Service Protocol for Level III was employed by measuring the plant communities using the line intercept method with 28 ft. transect line.
3) Left hillside suggests that there is probably a lot of soil moisture in the spring and early summer.
4) Water Spring is below this station.
5) Photo taken from left side.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

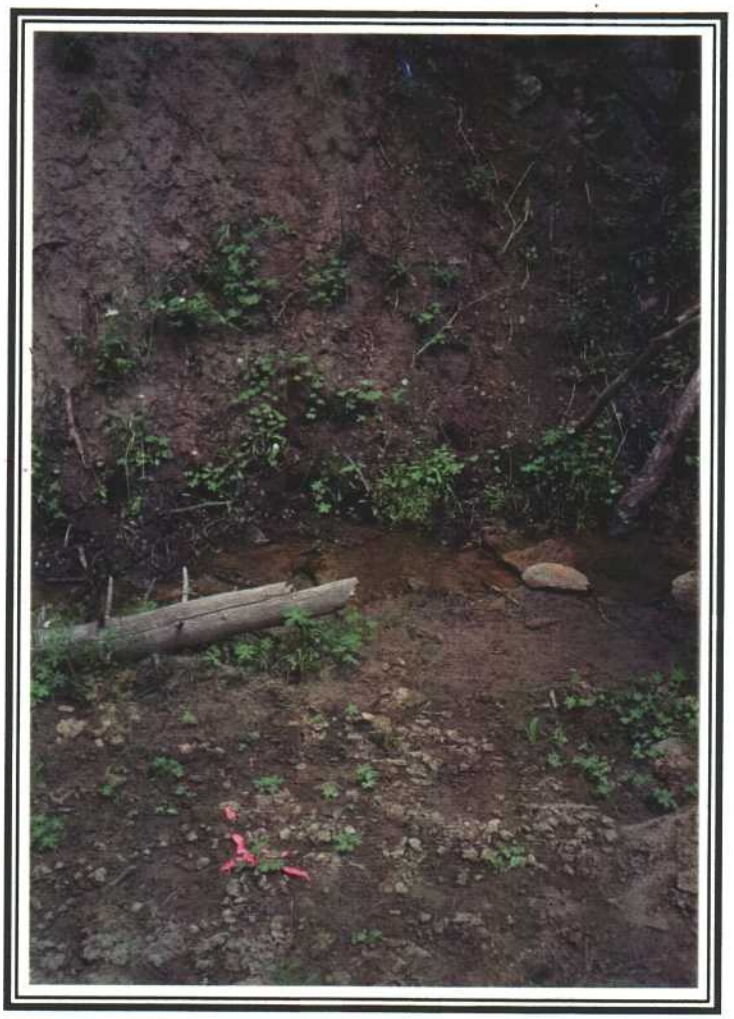
Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-10	RE-09	Left	2.5	*Geranium richardsonii/Agrostis stolonifera*
		Right	1.5	*Agrostis stolonifera/Equisetum arvense*
		Channel	2.0	Water

EFB-10 (RE-09): Cover using point quadrats (July 2004).

COVER BY SPECIES	Percent
TREES & SHRUBS	
FORBS	
Epilobium angustifolium	6.25
Erigeron divergens	6.25
Geranium richardsonii	6.25
GRASSES OR GRASS-LIKES	
TOTAL COVER	
LIVING COVER (vascular)	18.75
WATER	6.25
MOSS	0.00
LITTER	18.75
BAREGROUND	50.00
ROCK	6.25
TOTAL	100.00

Cover by Community Types (July 2004) - RE-09 (EFB-10)	
USDA Forest Service Protocol (1992)	
UPLAND VEGETATION	
Picea pungens	12.50
Populus tremuloides/Picea pungens	9.50
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Geranium richardsonii	4.00
TOTAL COVER (Upland Species)	22.00
TOTAL COVER (Riparian Species)	4.00
BAREGROUND	0.00
ROCK	0.00
WATER/MUD	2.00
TOTAL COVER	28.00

PHOTOGRAPHIC DOCUMENTATION



EFB-10 (RE-09)

RIPARIAN COMPLEX DATA SHEET
July 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-11

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 20 - 24, 2004

OBSERVER(S): P.D. Collins[2]

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Fm

ASPECT: NW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~3°

ELEVATION: 8,120 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
  - Scout Family Soils: 35 %
  - Doney Family Soils: 25%
  - Guben Family Soils: 25%
  - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

MORE SOILS INFORMATION:

- Soil Map Unit No. 20
- Family: Strych
- Composition:
  - Strych Family Soils: 30 %
  - Pathead Family Soils: 30%
  - Podo Family Soils: 15%
  - Rubbleland: 15%
  - Contrasting inclusions of rock outcrops, and finer textured soils: 10%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Aspen Right: Spruce/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 200 lbs/ac. (including woody species)

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Pachystima myrsinites*	*Cirsium sp.*	*Agrostis stolonifera*
Populus tremuloides	*Symphoricarpos oreophilus*	*Geranium richardsonii*	*Juncus longistylis*
Salix sp.		*Equisetum arvense*	*Carex lanuginosa*
Cornus sericea			
Betula occidentalis			

POOL ATTRIBUTES

% area in pools: 35

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 0

% bank length with overhanging vegetation: 35-40

BANK CONDITION

% bank length vegetated, stable: 65

% bank length unvegetated, stable: 30

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 5

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) This site is just below the confluence of a spring (EFB-S1). There was no water entering creek from this spring.
2) The stretch between EFB-10 and EFB-11 was mostly dry. There was a large mud slide in this area just upstream from EFB-11.
3) Quantitative Methods:

Oct. 2003: Point quadrats; sampled at 3 ft. intervals; 18 ft. transect on left side; 24 ft. transect on right side (plus 3 ft. water and 2 ft rock).

Jul. 2004: Point quadrats; sampled at 3 ft. intervals; 16 ft. transect on left side; 24 ft. transect on right side (plus 3 ft. water and 3 ft rock). Green Line: Also measured on these transects.

DATA SUMMARIES

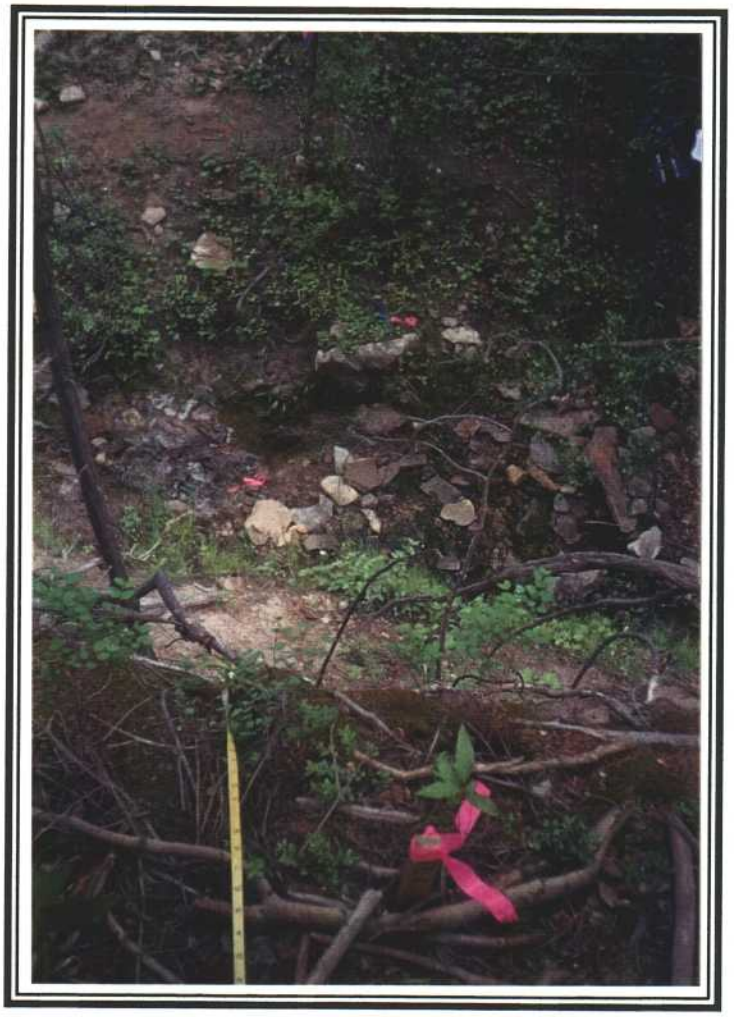
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-11		Left	1.0	*Equisetum arvense/Geranium richardsonii*
		Right	4.0	*Equisetum arvense/Geranium richardsonii*
		Channel	6.0	3.0 water; 3.0 rock

EFB-11: Cover using point quadrats (July 2004).

COVER BY SPECIES	Percent
TREES & SHRUBS	
Artemisia tridentata	6.67
Salix spp.	6.67
FORBS	
Erigeron divergens	6.67
Geranium richardsonii	13.33
GRASSES OR GRASS-LIKES	
TOTAL COVER	
LIVING COVER (vascular)	33.33
WATER	0.00
MOSS	6.67
LITTER	26.67
BAREGROUND	13.33
ROCK	20.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-11

RIPARIAN COMPLEX DATA SHEET

July 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-S1

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 20 - 24, 2004

OBSERVER(S): P.D. Collins[2]

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Fm

ASPECT: W

VALLEY BOTTOM TYPE: II

STREAM (SLOPE) GRADIENT: ~28°

ELEVATION: 8,120 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 20
- Family: Strych
- Composition:
  - Strych Family Soils: 30 %
  - Pathead Family Soils: 30%
  - Podo Family Soils: 15%
  - Rubbleland: 15%
  - Contrasting inclusions of rock outcrops, and finer textured soils: 10%

MORE SOILS INFORMATION:

- Soil Map Unit No. 107
- Family: Scout
- Composition:
  - Scout Family Soils: 35 %
  - Doney Family Soils: 25%
  - Guben Family Soils: 25%
  - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Aspen Right: Spruce/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: decreasing

ESTIMATED FORAGE PRODUCTION: 400 lbs./ac.

BEAVER ACTIVITY: none observed .

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Salix sp.*	*Equisetum arvense*	*Agrostis stolonifera*
Populus tremuloides		*Ranunculus cymbalaria*	*Carex lanuginosa*
	Symphoricarpos oreophilus	*Aster sp.*	*Elymus trachycaulus*
			Juncus arcticus

POOL ATTRIBUTES

% area in pools: 0

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 30

% bank length with overhanging vegetation: 40

BANK CONDITION

% bank length vegetated, stable: 90

% bank length unvegetated, stable: 5

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 5

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) A spring area, it is located about 50 ft. above confluence with the main channel of East Fork of Box Canyon.
2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. Green Line: Also measured on these transects.

3) I called the riparian community as 6 ft on the left and 6 ft on the right, but I could have added more because horsetail went about 7.5 ft more upslope (could be influenced by bank side groundwater).
4) There was not water cascading off rocks this sample period, but there was some surface water maintaining the riparian species at the station location.
5) Could not find the metal stakes marking sample area, so I monitored 10 ft of upland on each side.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

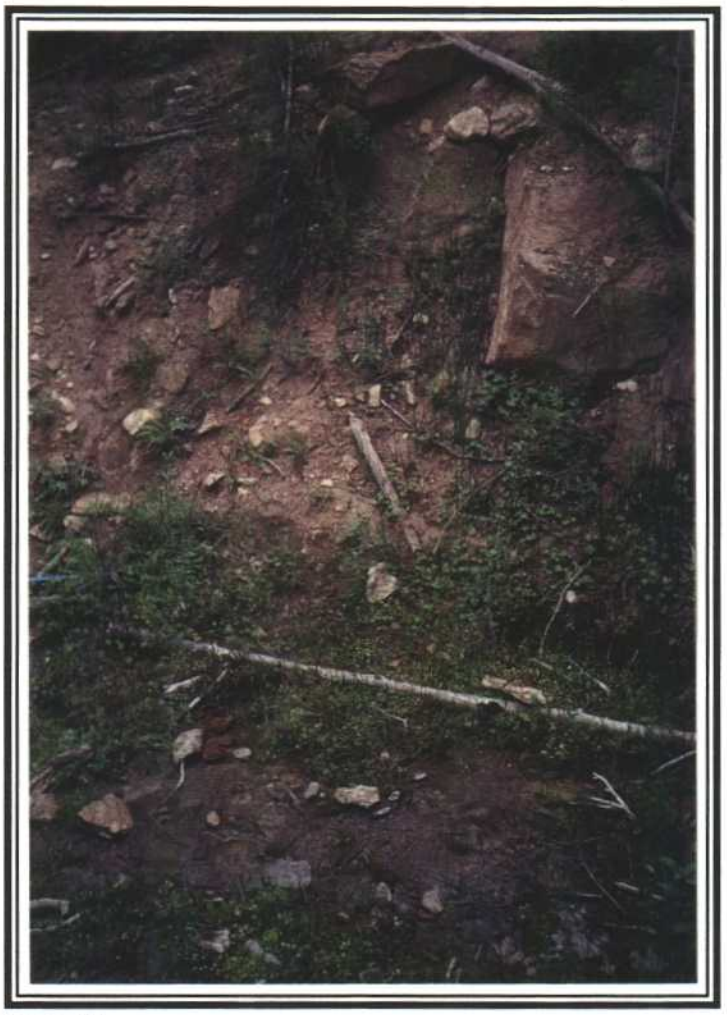
Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-S1		Left	6.0	*Carex lanuginosa/Equisetum arvense*
		Right	13.5	*Carex lanuginosa/Ranunculus cymbalaria*
		Channel	n/a	

Cover by Community Types (July 2004) - EFB-S1

USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Aster/Bareground	10.00
Elymus trachycaulus	10.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Carex lanuginosa/Ranunculus cymbalaria	13.50
Ranunculus cymbalaria/Equisetum arvensis	6.00
TOTAL COVER (Upland Species)	20.00
TOTAL COVER (Riparian Species)	19.50
BAREGROUND	n/a
ROCK	n/a
WATER/MUD	n/a
TOTAL COVER	39.50

PHOTOGRAPHIC DOCUMENTATION



EFB-S1

RIPARIAN COMPLEX DATA SHEET
July 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-S2 (EFB-12)

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 20 - 24, 2004

OBSERVER(S): P.D. Collins[2]

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss/Blackhawk Fm

ASPECT: W

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~30°

ELEVATION: 8,200 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
  - Scout Family Soils: 35 %
  - Doney Family Soils: 25%
  - Guben Family Soils: 25%
  - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

MORE SOILS INFORMATION:

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Picea pungens Right: Picea pungens

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: unstable

APPARENT FORAGE TREND: decreasing

ESTIMATED FORAGE PRODUCTION: 230 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Juniperus communis*	*Geranium richardsonii*	
Populus tremuloides	*Rosa woodsii*		
Lonicera involucrata			
Betula occidentalis			

POOL ATTRIBUTES

% area in pools: 0

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 100

% bank length with overhanging vegetation: 55

BANK CONDITION

% bank length vegetated, stable: 0

% bank length unvegetated, stable: 0

% bank length vegetated, unstable: 5

% bank length unvegetated, unstable: 95

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) This was an area that includes 2 springs near each other. Previous data (Oct. 2003) was taken at the head of the springs; water diffused downslope over a broad area in which data collection would have been difficult and possibly ambiguous.
2) The area was dry this sample period (Jul. 2004) due to a large sandstone cliff failure and rockslide over the entire spring area. A few riparian species remained, but not many. It's

basically an upland-looking community at this time.

3) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. I found both end stakes or the previous transect line. Green Line: Also measured on transects.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

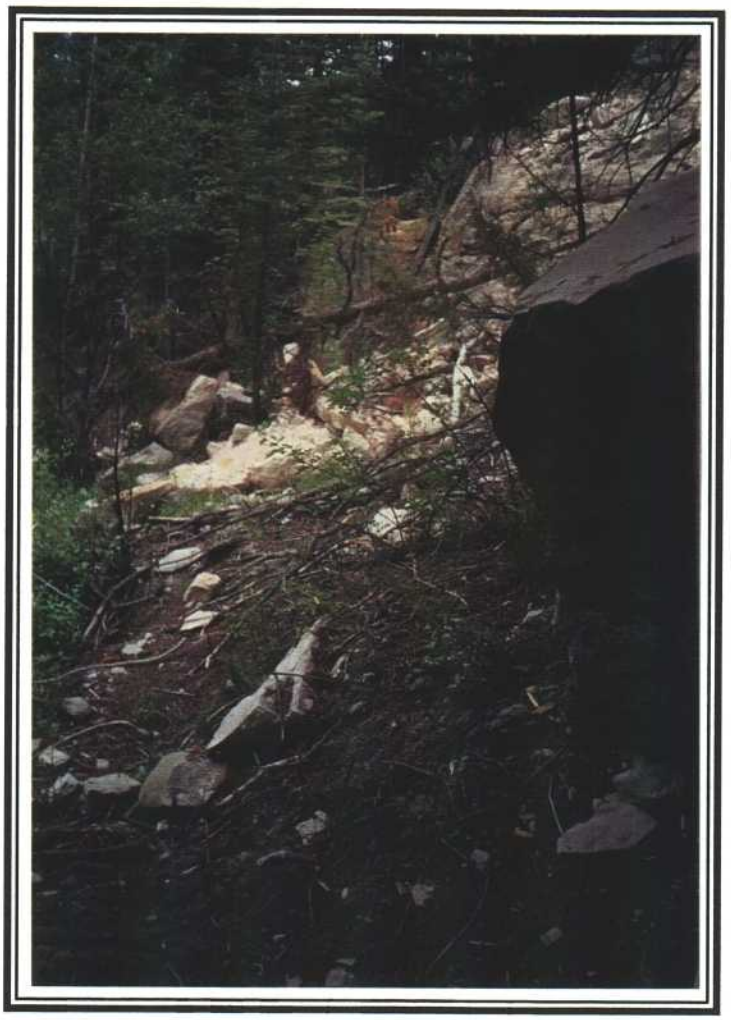
Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-S2	EFB-12	Left	12.0	*Geranium richardsonii*
		Right	4.0	*Geranium richardsonii*
		Channel	n/a	

Cover by Community Types (July 2004) - EFB-S2

USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Populus tremuloides/Picea pungens	63.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Geranium richardsonii	16.00
TOTAL COVER (Upland Species)	63.00
TOTAL COVER (Riparian Species)	16.00
BAREGROUND	n/a
ROCK	n/a
WATER/MUD	n/a
TOTAL COVER	79.00

PHOTOGRAPHIC DOCUMENTATION



EFB-S2 (EFB-12)

RIPARIAN COMPLEX DATA SHEET

July 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-S3 - North & South (EFB-13)

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 20 - 24, 2004

OBSERVER(S): P.D. Collins[2]

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss/Blackhawk Fm

ASPECT: W

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2-30°

ELEVATION: 8,245 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
  - Scout Family Soils: 35 %
  - Doney Family Soils: 25%
  - Guben Family Soils: 25%
  - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

MORE SOILS INFORMATION:

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Ponderosa Pine Right: Ponderosa Pine

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: unstable

APPARENT FORAGE TREND: decreasing

ESTIMATED FORAGE PRODUCTION: 50 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Symphoricarpos oreophilus*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides	*Juniperus communis*		
Pinus ponderosa	*Rosa woodsii*		
Acer glabrum			
Salix amygdaloides			

POOL ATTRIBUTES

% area in pools: 0

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 0

% bank length with overhanging vegetation: 50

BANK CONDITION

% bank length vegetated, stable: 10

% bank length unvegetated, stable: 90

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. Green Line: Also measured on these transects.

2) I found the found stakes. I measure north end and south end separately.
3) This spring area has gone dry.
4) Riparian species a present but they have decreased by 80-90%.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

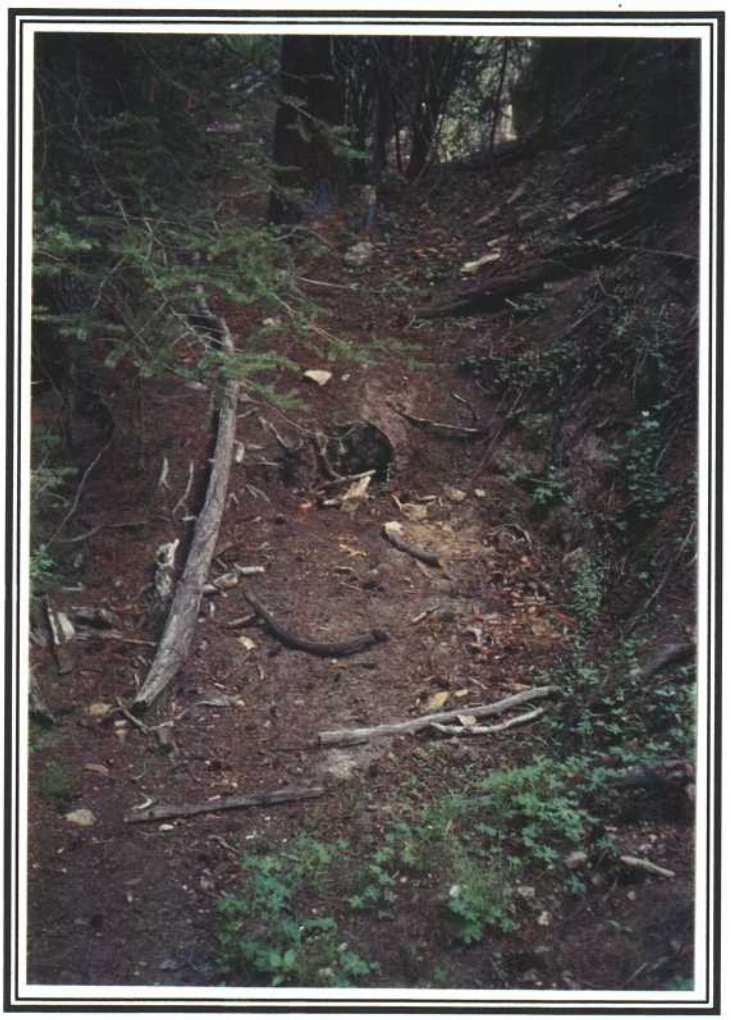
Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-S3	EFB-13	North	3.0	*Agrostis stolonifera/Ranunculus cymbalaria*
		South	1.0	*Agrostis stolonifera/Ranunculus cymbalaria*
		Channel	n/a	

Cover by Community Types (July 2004) - EFB-S3

USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Populus tremuloides/Picea pungens	57.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Ranunculus cymbalaria	4.00
TOTAL COVER (Upland Species)	57.00
TOTAL COVER (Riparian Species)	4.00
BAREGROUND	n/a
ROCK	n/a
WATER/MUD	n/a
TOTAL COVER	61.00

PHOTOGRAPHIC DOCUMENTATION



EFB-S3 (EFB-13)

RIPARIAN COMPLEX DATA SHEET
July 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-S4 (EFB-14)

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 20 - 24, 2004

OBSERVER(S): P.D. Collins[2]

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss/Blackhawk Fm

ASPECT: W

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~25°

ELEVATION: 8,240 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
  - Scout Family Soils: 35 %
  - Doney Family Soils: 25%
  - Guben Family Soils: 25%
  - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

MORE SOILS INFORMATION:

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Horsetail (uphill)/Spruce Right: Horsetail (uphill)/Spruce

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: unstable (recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: decreasing

ESTIMATED FORAGE PRODUCTION: 50 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Symphoricarpos oreophilus*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides	*Potentilla fruticosa*	*Geranium richardsonii*	
Salix amygdaloides	*Rosa woodsii*	*Equisetum arvense*	

POOL ATTRIBUTES

% area in pools: 0

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 0

% bank length with overhanging vegetation: 65

BANK CONDITION

% bank length vegetated, stable: 30

% bank length unvegetated, stable: 70

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Spring area. There was a seep here last sample period (Oct 2003). It was dry leaving bareground for this sample period (Jul 2004). Some riparian species remain, but they are stressed and dying out.
2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. Green Line: Also measured on these transects.
3) For some reason last sample period shows a 35 ft transect length. The sample period shows 25 ft. Could have been a mistake in Oct 2003; it is 25 ft for certain now.

DATA SUMMARIES

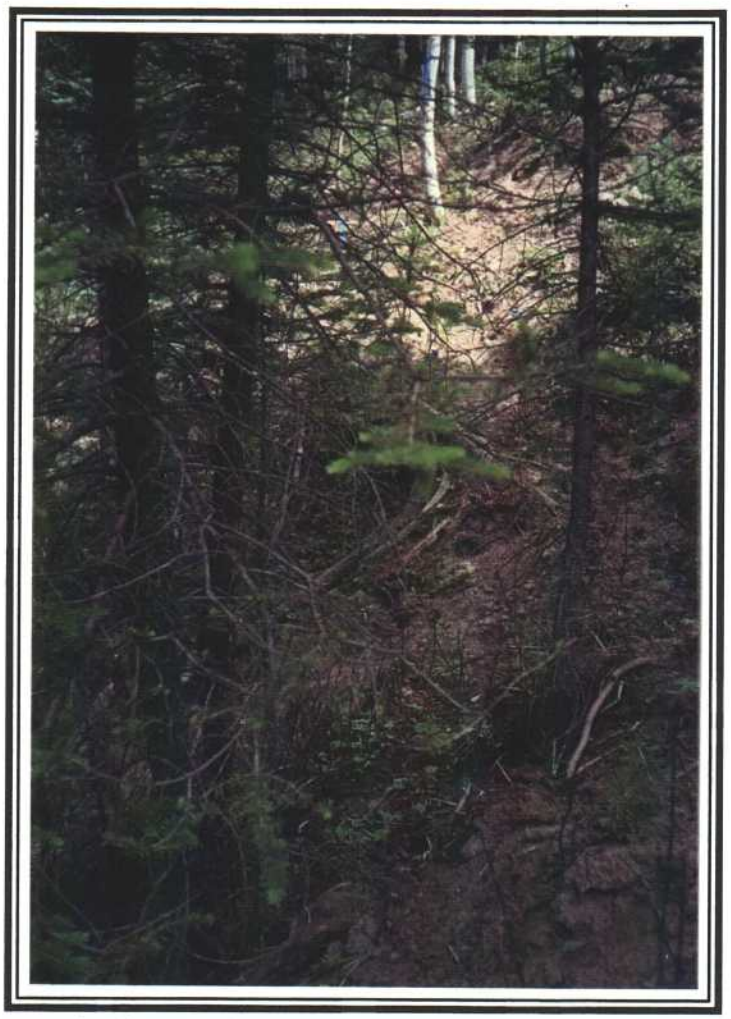
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-S4	EFB-14	Left	1.0	*Equisetum arvensis/Geranium richardsonii*
		Right	1.0	*Equisetum arvensis/Geranium richardsonii*
		Channel		dry

Cover by Community Types (July 2004) - EFB-S4

USDA Forest Service Protocol (1992)	(EFB-14)
UPLAND VEGETATION	
Populus tremuloides/Picea pungens	23.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Geranium richardsonii	2.00
TOTAL COVER (Upland Species)	23.00
TOTAL COVER (Riparian Species)	2.00
BAREGROUND	0.00
ROCK	0.00
WATER/MUD	0.00
TOTAL COVER	25.00

PHOTOGRAPHIC DOCUMENTATION



EFB-S4 (EFB-14)

RIPARIAN COMPLEX DATA SHEET
July 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number RE-11

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 20 - 24, 2004

OBSERVER(S): P.D. Collins[2]

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,265 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
  - Scout Family Soils: 35 %
  - Doney Family Soils: 25%
  - Guben Family Soils: 25%
  - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Wood's Rose/Aspen Right: Aspen/Spruce

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 80 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Rosa woodsii*		*Agrostis stolonifera*
Populus tremuloides		*Taraxacum officinale*	*Carex lanuginosa*
			Juncus arcticus
			Poa fendleriana

POOL ATTRIBUTES

% area in pools: 10

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 35

% bank length gently sloping (>135°): 0

% bank length with overhanging vegetation: 20

BANK CONDITION

% bank length vegetated, stable: 20

% bank length unvegetated, stable: 40

% bank length vegetated, unstable: 10

% bank length unvegetated, unstable: 30

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): unstable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Sideslopes were noted as unstable last fall. This sample period revealed that a large spruce tree had fallen directly in the sample area. The upland areas were unstable and movement of sample markers was observed. There were no riparian species in the transect area due to fallen tree and extensive cattle disturbance.

2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. Green Line: Also measured on these transects.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
RE-11		Left	0.0	*Agrostis stolonifera*
		Right	0.0	*Agrostis stolonifera*
		Channel	4.0	3.0 water; 1.0 mud

Cover by Community Types (July 2004) - RE-11

USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Populus tremuloides/Rosa woodsii	24.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
TOTAL COVER (Upland Species)	24.00
TOTAL COVER (Riparian Species)	0.00
BAREGROUND	0.00
ROCK	4.00
WATER/MUD	0.00
TOTAL COVER	28.00

PHOTOGRAPHIC DOCUMENTATION

RE-11

RIPARIAN COMPLEX DATA SHEET
July 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number RE-12

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 20 - 24, 2004

OBSERVER(S): P.D. Collins[2]

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,275 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
  - Scout Family Soils: 35 %
  - Doney Family Soils: 25%
  - Guben Family Soils: 25%
  - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%
  - o

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Sagebrush/Grass Right: Wood's Rose/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: decreasing

ESTIMATED FORAGE PRODUCTION: 500 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Populus tremuloides	*Salix sp.*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
	Artemisia tridentata	*Taraxacum officinale*	*Carex lanuginosa*
	Rosa woodsii	*Eriogonum sp.*	*Juncus longistylis.*
		Equisetum arvense	*Juncus arcticus*
			Poa secunda

POOL ATTRIBUTES

% area in pools: 10

% pool area made up of pools > 2' deep: 90

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 50

% bank length with overhanging vegetation: 5

BANK CONDITION

% bank length vegetated, stable: 85

% bank length unvegetated, stable: 15

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plantcommunities using the line intercept method. Green Line: Also measured on these transects.
2) Photo taken from left side.

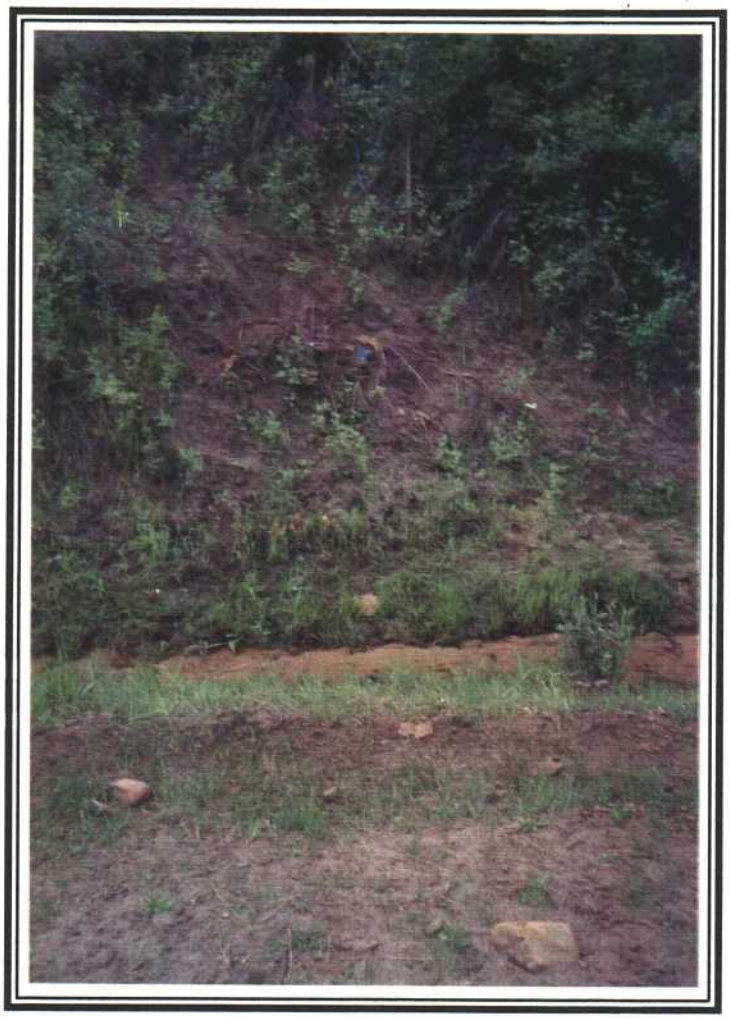
DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
RE-12		Left	5.0	*Agrostis stolonifera/Juncus longistylis*
		Right	3.0	*Agrostis stolonifera/Juncus longistylis*
		Channel	2.0	Water

Cover by Community Types (July 2004) - RE-12	
USDA Forest Service Protocol (1992)	
UPLAND VEGETATION	
Artemisia tridentata/Poa secunda	10.00
Populus tremuloides/Rosa woodsii	10.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Juncus longistylis	8.00
TOTAL COVER (Upland Species)	20.00
TOTAL COVER (Riparian Species)	8.00
BAREGROUND	0.00
ROCK	0.00
WATER/MUD	2.00
TOTAL COVER	30.00

PHOTOGRAPHIC DOCUMENTATION



RE-12

RIPARIAN COMPLEX DATA SHEET
July 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number RE-13

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 20 - 24, 2004

OBSERVER(S): P.D. Collins[2]

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: NW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,315 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen Right: Aspen/Ponderosa Pine

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: decreasing

ESTIMATED FORAGE PRODUCTION: 200lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Artemisia tridentata*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides	*Potentilla fruticosa*	*Equisetum arvense*	*Carex lanuginosa*
Pinus ponderosa	*Symphoricarpos oreophilus*	*Artemisia dracunculus*	*Festuca ovina*
		Erigeron divergens.	*Juncus sp.*
		Fragaria vesca	*Elymus trachycaulus*
		Lupinus sp.	

POOL ATTRIBUTES

% area in pools: n/a (no water at this site)
% pool area made up of pools > 2' deep: n/a (no water at this site)

AQUATIC VEGETATION

% streambed with filamentous algae: n/a (no water at this site)
% stream margin with rooted aquatic: n/a (no water at this site)

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0
% bank length gently sloping (>135°): 0
% bank length with overhanging vegetation: 20

BANK CONDITION

% bank length vegetated, stable: 90
% bank length unvegetated, stable: 10
% bank length vegetated, unstable: 0
% bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Photo taken from right side.
2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. Green Line: Also measured on these transects.
3) Lots of bareground that was probably caused by cattle use (more than general data suggested).
4) The upland side-slopes were unstable.
5) Dry streambed.

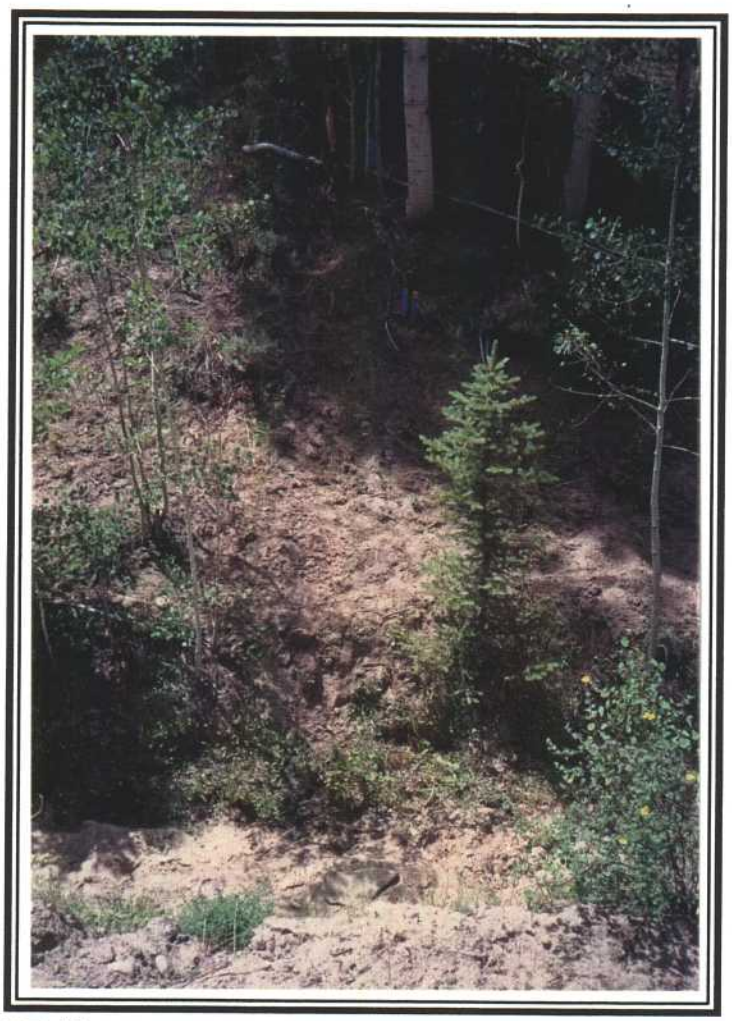
DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
RE-13		Left	3.5	*Agrostis stolonifera/Ranunculus cymbalaria*
		Right	1.5	*Agrostis stolonifera/Ranunculus cymbalaria*
		Channel	1.5	Dry

Cover by Community Types (July 2004) - RE-13	
USDA Forest Service Protocol (1992)	
UPLAND VEGETATION	
Artemisia tridentata/Elymus trachycaulus	6.00
Populus tremuloides	12.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Ranunculus cymbalaria	5.00
TOTAL COVER (Upland Species)	18.00
TOTAL COVER (Riparian Species)	5.00
BAREGROUND	0.00
ROCK	4.00
WATER/MUD	2.00
TOTAL COVER	29.00

PHOTOGRAPHIC DOCUMENTATION



RE-13

RIPARIAN COMPLEX DATA SHEET
July 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-07

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 20 - 24, 2004

OBSERVER(S): P.D. Collins[2]

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: NW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,220 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Aspen Right: Aspen/Spruce

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: decreasing

ESTIMATED FORAGE PRODUCTION: 100 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Juniperus communis*		*Agrostis stolonifera*
Populus tremuloides	*Potentilla fruticosa*	*Erigeron sp.*	*Carex lanuginosa*
Betula occidentalis	*Rosa woodsii*	*Achillea millefolium*	*Juncus longistylis*
		Equisetum arvense	
		Geranium richardsonii	
		Urtica dioica	

POOL ATTRIBUTES

% area in pools: 0 (no water at this site)
% pool area made up of pools > 2' deep: 0 (no water at this site)

AQUATIC VEGETATION

% streambed with filamentous algae: 0 (no water at this site)
% stream margin with rooted aquatic: 0 (no water at this site)

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 25
% bank length gently sloping (>135°): 50
% bank length with overhanging vegetation: 40

BANK CONDITION

% bank length vegetated, stable: 30
% bank length unvegetated, stable: 40
% bank length vegetated, unstable: 5
% bank length unvegetated, unstable: 25

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable (left side); unstable (right side)

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Photo taken from the left side
2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. Tape measurement went up and down

both sides of the large boulder in the channel. If I did not put tape down backside of rock the total length would have been 35 ft. like what was recorded in Oct. 2003. In Jul 2004 a 40 ft. transect length was recorded. Green Line: Also measured on these transects.

3) There were cattle trails in area, but no fresh tracks.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

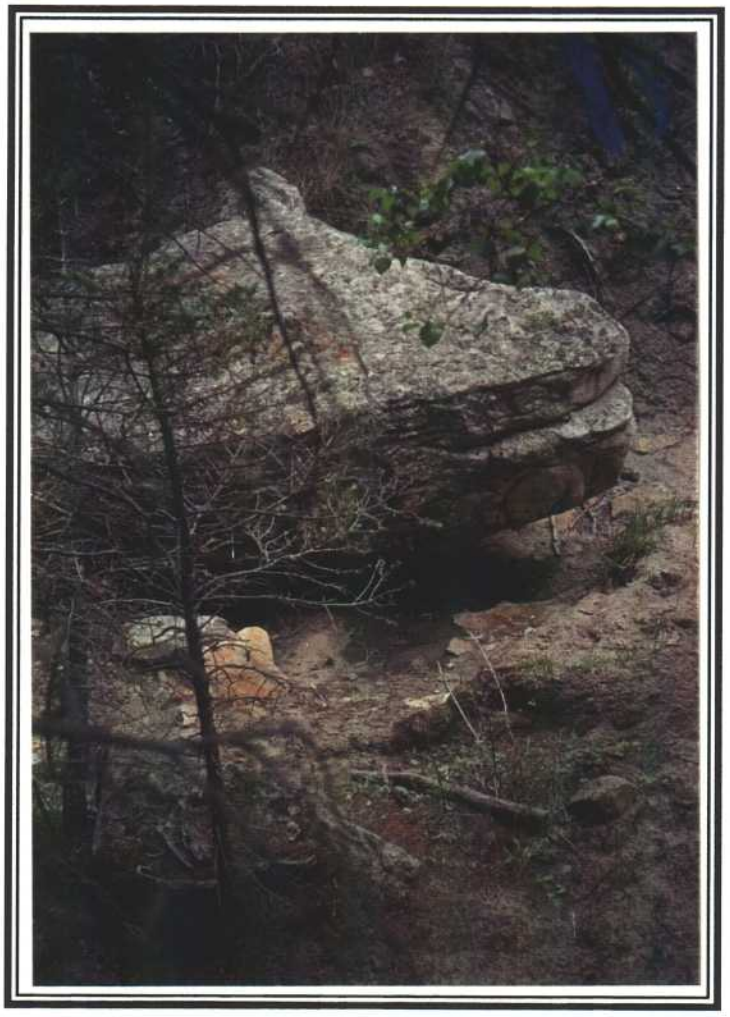
Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-07		Left	1.0	*Agrostis stolonifera/Carex lanuginosa*
		Right	0	
		Channel	18.0	Bareground

Cover by Community Types (July 2004) - R-7

USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Picea pungens	10.00
Populus tremuloides	11.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Carex lanuginosa/Agrostis stolonifera	1.00
TOTAL COVER (Upland Species)	21.00
TOTAL COVER (Riparian Species)	1.00
BAREGROUND	14.00
ROCK	4.00
WATER/MUD	0.00
TOTAL COVER	40.00

PHOTOGRAPHIC DOCUMENTATION



R-07

RIPARIAN COMPLEX DATA SHEET

July 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-09

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 20 - 24, 2004

OBSERVER(S): P.D. Collins[2]

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,210 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Aspen Right: Aspen/Horsetail

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 300 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Salix lutea.*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides	*Artemisia tridentata*	*Equisetum arvense*	*Juncus longistylis*
Juniperus scopulorum	*Rosa woodsii*	*Urtica dioica*	
Betula occidentalis		*Taraxacum officinale*	
		Geranium richardsonii	

POOL ATTRIBUTES

% area in pools: 50

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 50

% bank length with overhanging vegetation: 25

BANK CONDITION

% bank length vegetated, stable: 75

% bank length unvegetated, stable: 25

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): moderately stable (left side); stable (right side)

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Photo taken from the left side.
2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. Green Line: Also measured on these transects.

3) On the left side of the river there was about 8 ft wide area of redtop that it was uncertain where the water that supports it comes from (hillside seeps or stream).
4) The right side had hillside water influence.
5) There was some fairly recent cattle use here.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-09		Left	13.5	*Agrostis stolonifera/Equisetum arvense*
		Right	2.5	*Ranunculus cymbalaria/Equisetum arvense*
		Channel	2.0	Water

Cover by Community Types (July 2004) - R-9
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Equisetum arvensis/Agrostis stolonifera (hillside)	12.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Equisetum arvensis	13.50
Ranunculus cymbalaria/Equisetum arvensis	2.50
TOTAL COVER (Upland Species)	12.00
TOTAL COVER (Riparian Species)	16.00
BAREGROUND	0.00
ROCK	0.00
WATER/MUD	2.00
TOTAL COVER	30.00

PHOTOGRAPHIC DOCUMENTATION

R-09

RIPARIAN COMPLEX DATA SHEET
July 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-11

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 20 - 24, 2004

OBSERVER(S): P.D. Collins[2]

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: NNW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,180 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Grass Right: Aspen/Wood's Rose

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 300 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Rosa woodsii*	*Epilobium angustifolium*	*Agrostis stolonifera*
Populus tremuloides		*Equisetum arvense*	*Juncus longistylis*
Betula occidentalis		*Ranunculus cymbalaria*	*Poa secunda*
		Achillea millefolium	

POOL ATTRIBUTES

% area in pools: 50

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 25

% bank length gently sloping (>135°): 50

% bank length with overhanging vegetation: 0

BANK CONDITION

% bank length vegetated, stable: 50

% bank length unvegetated, stable: 25

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 25

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): moderately stable (left side); stable (right side)

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Photograph taken from the left side.
2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. Green Line: Also measured on these transects.

3) The right side had an upper bank with riparian vegetation; riparian vegetation was also present near streamside.
4) On the right side the bank was mostly a large boulder and unstable soil (mud).

DATA SUMMARIES

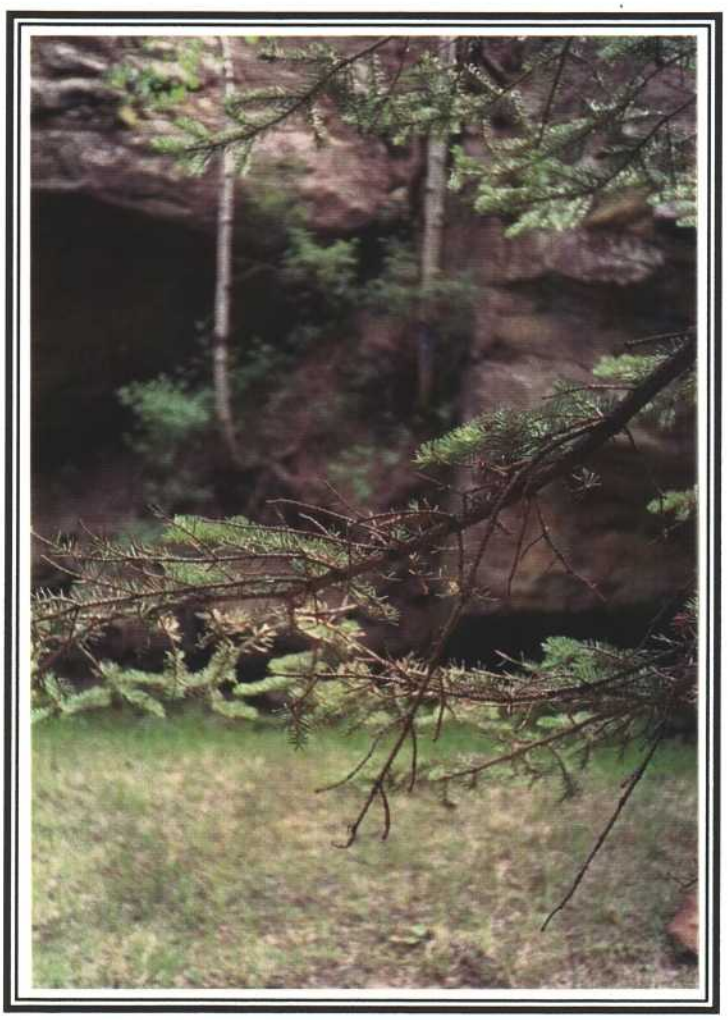
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-11		Left	10.0	*Equisetum arvense/Agrostis stolonifera/Juncus longistylis*
		Right	0	
		Channel	1.0	Water

Cover by Community Types (July 2004) - R-11

USDA Forest Service Protocol (1992)	
UPLAND VEGETATION	
Picea pungens/Poa secunda	10.00
Populus tremuloides/Rosa woodsii	10.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Juncus longistylis	5.00
Ranunculus cymbalaria/Equisetum arvensis	5.00
TOTAL COVER (Upland Species)	20.00
TOTAL COVER (Riparian Species)	10.00
BAREGROUND	0.00
ROCK	1.00
WATER/MUD	1.00
TOTAL COVER	32.00

PHOTOGRAPHIC DOCUMENTATION



R-11

RIPARIAN COMPLEX DATA SHEET
July 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-13

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 20 - 24, 2004

OBSERVER(S): P.D. Collins[2]

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: NNW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,175 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce Right: Spruce/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: moderately stable

ESTIMATED FORAGE PRODUCTION: 500 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens		*Equisetum arvense*	*Agrostis stolonifera*
Populus tremuloides	*Potentilla fruticosa*	*Geranium richardsonii*	*Carex lanuginosa*
Salix lutea	*Juniperus communis*	*Achillea millefolium*	*Juncus longistylis*

POOL ATTRIBUTES

% area in pools: 0

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 20

% bank length gently sloping (>135°): 10

% bank length with overhanging vegetation: 25

BANK CONDITION

% bank length vegetated, stable: 75

% bank length unvegetated, stable: 15

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 15

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) There was a discrepancy with total transect length between 1999 (42 ft.) and Oct 2003 (45 ft.); July 2004 was consistent at 45 ft.
2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. Green Line: Also measured on these transects.
3) Photograph taken from the left side.

4) The upper banks were wetland and probably influenced by the stream water.
5) The site was muddy (no surface water).

DATA SUMMARIES

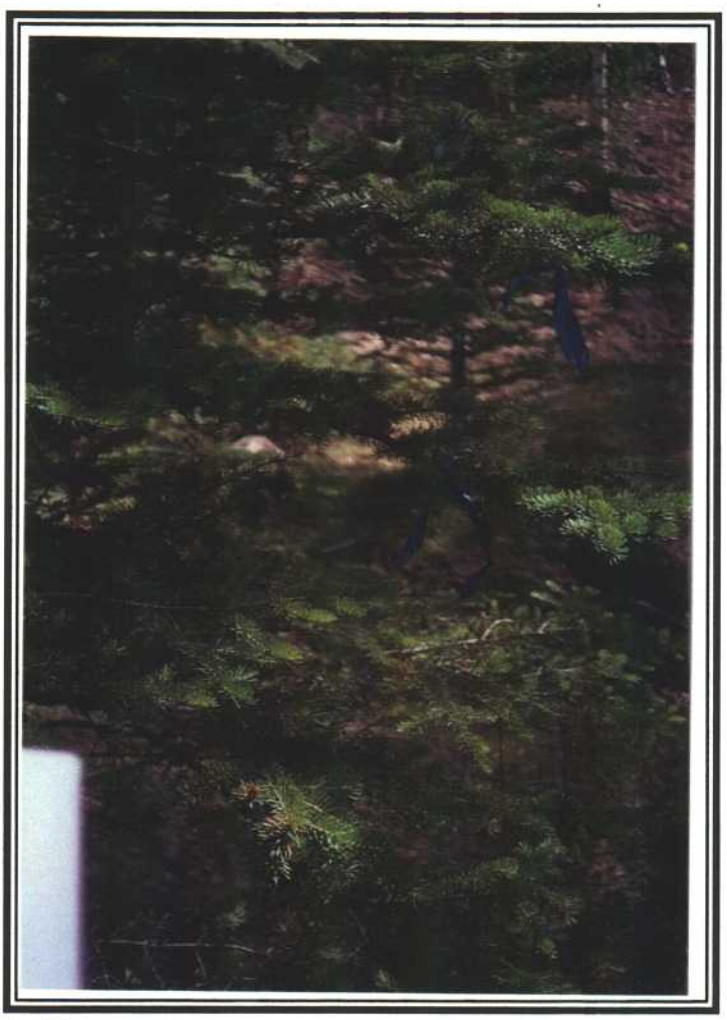
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-13		Left	16.5	*Carex lanuginosa/Agrostis stoloniferal Agrostis stolonifer/Salix lutea*
		Right	13.5	*Agrostis stolonifer/Salix lutea/Carex lanuginosa*
		Channel	2.0	Bareground

Cover by Community Types (July 2004) - R-13
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Bromus carinatus	13.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Salix lucida	23.00
Carex lanuginosa/Agrostis stolonifera	7.00
Equisetum arvensis	0.00
TOTAL COVER (Upland Species)	13.00
TOTAL COVER (Riparian Species)	30.00
BAREGROUND	2.00
ROCK	0.00
WATER/MUD	0.00
TOTAL COVER	45.00

PHOTOGRAPHIC DOCUMENTATION



R-13

RIPARIAN COMPLEX DATA SHEET
July 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-15

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 20 - 24, 2004

OBSERVER(S): P.D. Collins[2]

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss (Blackhawk Fm just upstream)

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,170 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Aspen Right: Spruce

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: active movement (not climax)

APPARENT FORAGE TREND: moderately stable

ESTIMATED FORAGE PRODUCTION: 100 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Juniperus communis*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides	*Symphoricarpos oreophilus*	*Equisetum arvense*	*Carex lanuginosa*
Cornus stolonifera	*Salix lutea*	*Epilobium angustifolium*	
		Urtica dioica	

POOL ATTRIBUTES

% area in pools: 40

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 40

% bank length gently sloping (>135°): 40

% bank length with overhanging vegetation: 15

BANK CONDITION

% bank length vegetated, stable: 65

% bank length unvegetated, stable: 15

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 20

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable (left side); unstable (right side)

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Left side had horsetail in the "upland" area, but it was high enough in elevation that we felt it was influenced by side-slope water.
2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. Green Line: Also measured on these transects.
3) Length of transect line in Oct. 2003 was less than 1999 due to movement; in July 2004 it was

the same as Oct. 2003.

4) Photo from 1999 was from a different place (stake number indicated I was in the correct location in Oct 2003 and July 2004).

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

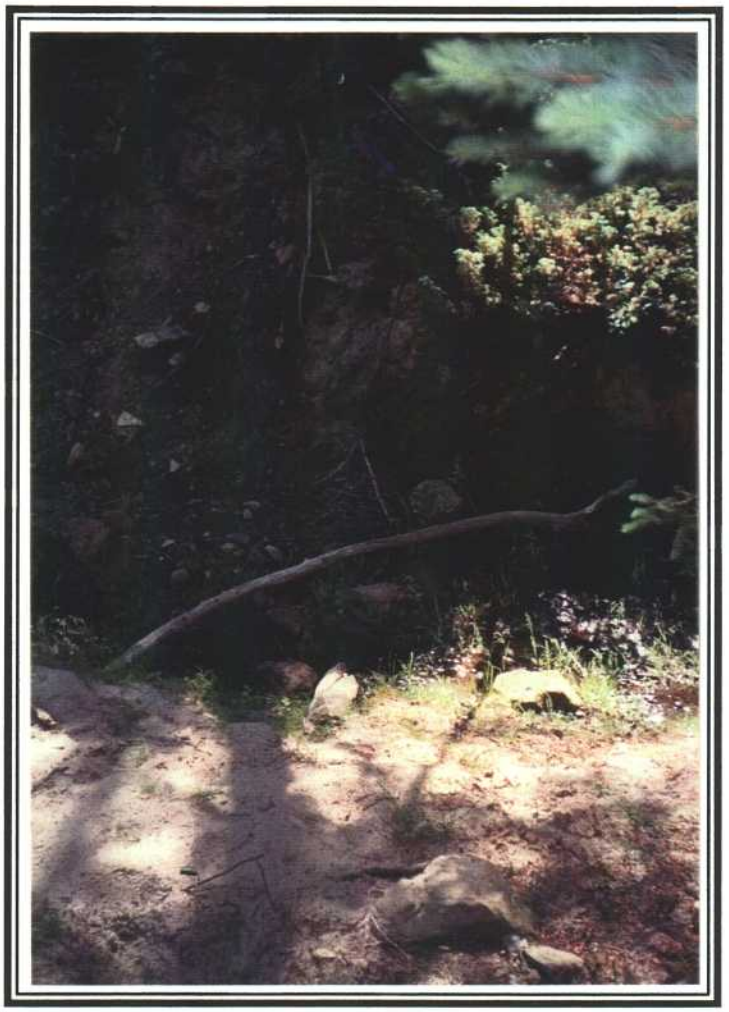
Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-15		Left	2.0	*Equisetum arvense/Agrostis stolonifera*
		Right	4.0	*Equisetum arvense/Agrostis stolonifera*
		Channel	1.0	Water

Cover by Community Types (July 2004) - R-15

USDA Forest Service Protocol (1992)

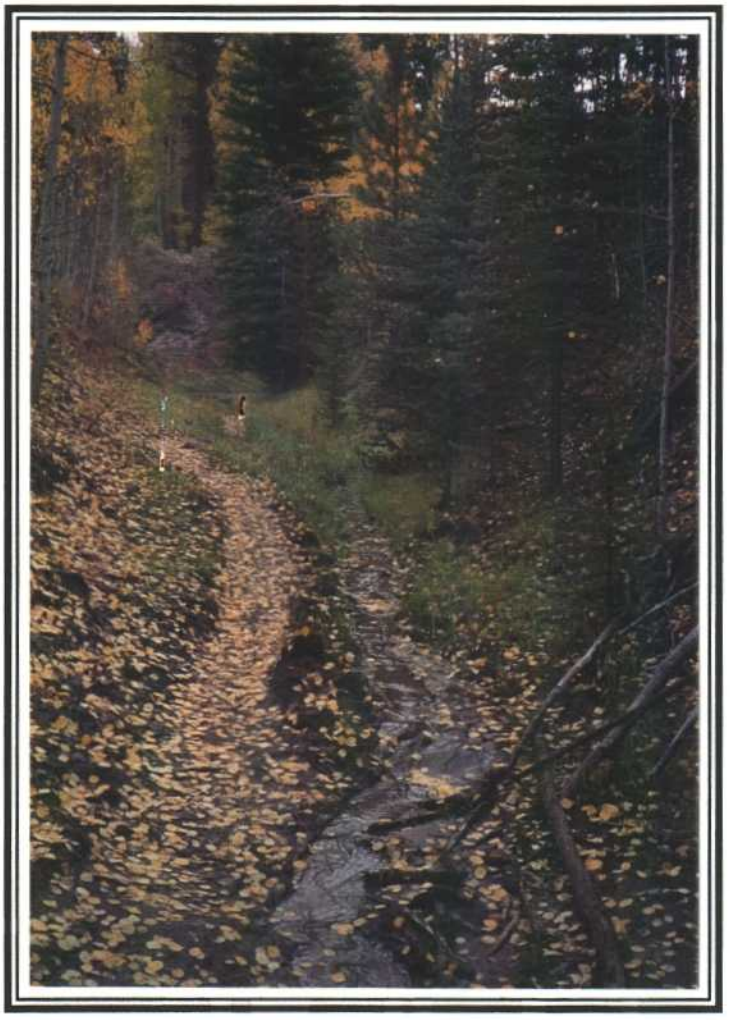
UPLAND VEGETATION	
Picea pungens	16.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Equisetum arvensis	6.00
TOTAL COVER (Upland Species)	16.00
TOTAL COVER (Riparian Species)	6.00
BAREGROUND	0.00
ROCK	3.00
WATER/MUD	1.00
TOTAL COVER	26.00

PHOTOGRAPHIC DOCUMENTATION



R-15

Riparian Plant Communities
in the
East Fork of Box Canyon
- October 2004 -



A Vegetation Monitoring Study for the SUFCO Mine: October 2004

Prepared by

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SCOPE

Quantitative and qualitative baseline vegetation data were recorded in several locations in the East Fork of Box Canyon in **October 2004**. Additionally, data were also recorded in several locations in the Main Fork of Box Canyon. These data sets may be used for controls to the study.

Coal mining activities were scheduled and conducted under the East Fork of Box Canyon during the winter of 2003-04. This document provides the *third* sample period of baseline data for the existing riparian plant communities in the two forks of Box Canyon. The *first* sample period was in the October 2003, prior to the mining activities below the East Fork (this final report was called *Riparian Plant Communities in the East Fork of Box Canyon - 2003*; the report date was March 2004). The *second* sample period was in July 2004 after mining had occurred under the canyon (the final report was called *Riparian Plant Communities in the East Fork of Box Canyon: July 2004*; the final report was dated February 2005).

INTRODUCTION

As described in the earlier report, the Box Canyons and their drainages are located at the southern end of the Wasatch Plateau which is a subprovince of the Colorado Plateau Physiographic Province. This area is west of the town of Emery, Utah in Sevier County and is located within the Manti-LaSal National Forest. The Box Canyon drainages are tributaries to Muddy Creek which runs into the Dirty Devil River and ultimately drains into the Colorado River. Geology of the study areas were within the Cretaceous strata of the Mesa Verde Group. The upper portions of the study area were comprised of rocks and soils derived from the cliff-forming Castlegate Sandstone. The lower reaches of the study area encounters shales of the Blackhawk Formation. Elevation of the study area was between 8,000 ft to 8,500 ft above sea level.

This study concentrated on the riparian plant communities within the East Fork of Box Canyon because underground mining had been proposed in this area. However, because no mining was planned underneath the Main Fork of Box Canyon, some control transects were also placed in this drainage.

A variety of biological and other resource information can be studied to evaluate and characterize riparian complexes including vegetation, geology, channel morphology, aquatic biology, soils, and stream flow. The primary focus of this study was on the vegetation as to provide baseline and followup information by monitoring the riparian communities in the East Fork of Box Canyon. Regular monitoring should provide data to determine long term trends, natural variability and benchmark information including the possible impacts on the riparian plant communities from mining beneath the creek.

Like the previous studies, this study primarily employed vegetation monitoring methods described by the USDA Forest Service for a "Level III Riparian Area Evaluation". The design of this study will not provide data that could show subtle changes to community structure and species

composition as a result of *minor* changes to the riparian habitat. Rather, the study was designed to be compared with earlier (and future) studies in an attempt to document *major* impacts to the plant communities along the stream due to catastrophic events, such as loss of water and habitat from the effects of subsidence caused from underground mining. (**Note**: On the data sheets in one of the aforementioned studies (the final report was called *Riparian Plant Communities in the East Fork of Box Canyon - 2003*, the report date was March 2004), a typographical error indicated that the data were recorded from October 6-10, 2004. The dates should have been October 6-10, 2003).

METHODS

Sample station locations were pre-determined from an earlier field visit in 2003 by a team of specialists and representatives from the State of Utah, Division of Oil, Gas & Mining (DOGM), Canyon Fuel Company (CFC), USDA Forest Service (USFS), Mt. Nebo Scientific, Inc. and other consultants. These stations were placed in areas with the intent to provide similar study areas where data could be recorded in several disciplines including biology, hydrology and geology. These sample stations are called "team stations" in this report.

The vegetation monitoring methods of the study was principally based on those described by the USDA Forest Service for a *"Level III Riparian Area Evaluation"* (Integrated Riparian Evaluation Guide, March 1992), but does expand on those methodologies.

Qualitative and quantitative data were recorded at each sample location. Although some maintenance may be required, locations and extent of the line transects were permanently marked using numbered and flagged wooden stakes and 12-inch metal nails. Photographic stations for documentation and future comparisons were established at each sample location.

In this report, when reference is made to the left or right side of the drainage, this means "river

RIPARIAN COMPLEX DATA SHEET

CLIENT:
COMPLEX: Riverine - Number
WATERBODY NAME:
LOCATION:
DATE:
OBSERVER(S):
QUAD NAME:
GEOLOGIC PARENT MATERIAL:
ASPECT:
VALLEY BOTTOM TYPE:
STREAM GRADIENT:
ELEVATION: .
SIZE OF COMPLEX:
SOILS INFORMATION:
ADJACENT UPLAND VEGETATION (looking downstream)
Left: Right:
VEGETATIVE DESCRIPTION (Dominance by Community Types)
SUCCESSIONAL STATUS:
APPARENT FORAGE TREND:
ESTIMATED FORAGE PRODUCTION:
BEAVER ACTIVITY:
PHOTOGRAPH TAKEN: (from right side unless otherwise stated)
LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA:
SPECIES OBSERVED:
POOL ATTRIBUTES
- % area in pools:
- % pool area made up of pools > 2' deep:

AQUATIC VEGETATION
- % streambed with filamentous algae:
- % stream margin with rooted aquatic:

BANK TYPE & VEGETATION OVERHANG
- % bank length undercut (<90°):
- % bank length gently sloping (>135°):
- % bank length with overhanging vegetation:

BANK CONDITION (bankfull area only)
- % bank length vegetated, stable:
- % bank length unvegetated, stable:
- % bank length vegetated, unstable:
- % bank length unvegetated, unstable:

BANK STABILITY (near water line):
CHANNEL MORPHOLOGY
NOTES:

left" or "river right", *as characterized by looking downstream.*

Qualitative Data

The "Riparian Complex Data Sheet" on the previous page lists all of the qualitative data (and some of the quantitative data) that were collected at all sample stations.

Quantitative Data

As mentioned previously, USFS protocol was utilized for the study. However, to increase the level of detail, some modifications to this protocol were employed to those sample areas chosen by the team specialists (team stations). The primary reason for the modifications were twofold. First, it will provide more diverse data sets, or other ways to measure potential changes to the vegetation in the canyons. Second, there is an existing baseline data set that was recorded in 1999 for the riparian communities in the two Box Canyons. With only a couple of exceptions, the sample areas in the 1999 data set were different than the team stations of the subsequent studies. Although data were recorded in 2003 and 2004 at some of the same sample locations as were used in 1999, in an attempt to maintain standardized data sets, the modifications to the protocol were not made at these stations. Some of the 1999 stations were located for the 2003 and 2004 studies so that, if necessary, they may provide worthwhile information through time that otherwise would not have been available with one baseline data set. (*One note of caution, however, is that the 2003 and 2004 data sets were not designed specifically to be compared with the 1999 data – there may be some issues or problems associated with these comparisons*).

With the one exception to the protocol modification mentioned above, the parameters for all sample stations in the 2003 and 2004 studies were identical. The modification to the USFS protocol was in the methods that cover data were recorded. Depending on the site, three different methods were employed to measure cover. They are explained below.

Total Cover

For all the team stations, "total cover" was recorded. First, transect lines were established perpendicular to the stream channel. With a few exceptions such as constraints imposed by rock ledges or other topographical features, the transect line lengths were consistent, or 24 ft. on each side of the stream. The length of the transect lines extended far enough upslope to insure that they also included upland vegetation types (usually 3 quadrats on each side) as well as the riparian vegetation being sampled. The transect lines on each side of the stream began at the bottomland near the edge of the water, or where the riparian vegetation began. In some cases, no water was present at a given sample site. In those instances, the transect lines began where the water would normally be present (i.e. sandy or rock bottom). Water or dry channel widths were measured and added to the total length of the transects.

Regular points were placed at 3 ft. intervals on the transect lines. At these points, point quadrats

were used to record the total cover. Cover by these "hits" could include the plant species, moss, litter, bareground or rock. Therefore, total cover when the data were summarized, included 1) percent of the living cover of each plant species, 2) total living cover (vascular), 3) total living cover (nonvascular), 4) litter cover, 5) bareground cover, and 6) rock cover.

Community Type Cover

The Community Type Cover was one method to record cover in the USFS Level III protocol and was used in those additional areas that were added to the riparian study. In other words, these areas were part of the 1999 study and were added to the study **in addition to** those chosen by the team. (In a few areas, the sample locations chosen by the team and those from the 1999 study were the same – in those cases, both methods for estimating cover were employed).

At these locations permanently marked transects lines had previously been placed across (or perpendicular to) the stream channel. The line transects had varied lengths by design which were based on several factors. Although sometimes limited by topographical features such as sandstone cliffs, the intent was to make the transects long enough to cover the entire stream, its riparian communities, plus an additional 10 ft on each side of the stream to record the adjacent upland communities. Monitoring the total extent of the riparian plant communities including some upland community information should provide information about possible increases or decreases in the riparian communities relative to the adjacent upland communities.

Once the transect was placed, the line-intercept method was employed measuring the extent of each major riparian plant community. The plant communities were named by the dominant two plant species. If only one species dominated the community by a wide margin, the plant community was named by this single species. In this method, cover by each plant species is not calculated.

Green Line Cover

In addition to the methods for estimating cover described above, "Green Line" cover was also recorded at *all sample locations*. This method consisted of using a tape to measure the riparian community (Green Line) on each side of the stream. Similar to the Community Type cover described above, the dominant one or two species were listed with each measurement. Results from the Green Line method is similar to the Community Type method in that it quantifies the extent of the riparian community of each sample site. Differences are that the Green Line method separates the riparian data for each side of the stream, whereas the Community Type method provides total cover including: riparian community types, upland community types, bareground, litter, rock and stream.

Site Numbers

The sample sites that were pre-determined by the team of specialists (team stations) that will be used for studies other than those for this report were numbered accordingly and will be consistent with those other studies (geology and hydrology). However, those additional sites that were chosen to supplement the data sets, or the subset of riparian sites that were sampled in 1999, were numbered to be consistent with those sample sites. In some cases, they are the same location. A summary to clarify the numbered sites and the cover sampling method used at each site is shown in the RESULTS section below.

RESULTS

Listed below is a summary of the sample locations, site numbers and protocol used.

Sample Site Number	Other Name or Number	USFS Level III Protocol	Cover Protocol: Green Line	Cover Protocol: Point Quadrat	Cover Protocol: Community Type
EFB-1		X	X	X	
EFB-2		X	X	X	
EFB-3		X	X	X	
EFB-4		X	X	X	
EFB-5		X	X	X	
EFB-6		X	X	X	
EFB-7		X	X	X	
EFB-8		X	X	X	
EFB-9	RE-10	X	X	X	X
EFB-10	RE-09	X	X	X	X
EFB-11		X	X	X	
EFB-S1*		X	X		X
EFB-S2*	EFB-12	X	X		X
EFB-S3*	EFB-13	X	X		X
EFB-S4*	EFB-14	X	X		X
RE-11		X	X		X
RE-12		X	X		X
RE-13		X	X		X
R-07		X	X		X
R-09		X	X		X
R-11		X	X		X
R-13		X	X		X
R-15		X	X		X
*S= Spring					

Sample results are shown for each site on the data sheets in this report. Each sheet shows all qualitative and quantitative data recorded as well as photographic documentation.

DISCUSSION & SUMMARY

Results from monitoring the riparian communities in late-September and early-October 2004 in the East Fork of Box Canyon have been included in this report. The USDA Forest Service protocol and other methods were employed to monitor the riparian communities. These methods utilized results from qualitative data of the riparian complex such as geology, geomorphology, biology, physiognomy, soils, and channel characteristics as part of the data collection process. Quantitative data were also recorded from the riparian plant communities. The methods used to record cover data at the team stations employed the use of point quadrats to record *Total Cover*. Additional sample stations from a previous study (1999) were also added to the sampling regimes in October 2003, July 2004, and October 2004. Five of these sample stations were located in the East Fork of Box Canyon and five were in the Main Fork of Box Canyon. Methodologies to estimate cover (*Community Cover*) for the additional sites remained consistent with the earlier studies so that comparisons could be made in the future. A method referred to as the *Green Line Method* for measuring the riparian communities was also employed at all sample locations. A summary of all qualitative and quantitative data taken at each sample location are shown in the RESULTS section of this report.

The final report for the previous sample period (July 2004) indicated a negative trend in the size of the riparian communities when compared to an earlier sample period (October 2003), especially in the sample locations where springs had been identified. These trends, although the differences were not as significant, were also apparent in the Main Fork of Box Canyon (used as a control area).

When the results of this sample period (October 2004) were compared with the previous sample period (July 2004), a reverse trend is suggested in the *Green Line Method* – or the riparian communities increased somewhat. The *Community Cover Method*, however, showed no significant change. When the results of sample periods from the same season are compared (October 2003 vs. October 2004), the trends for the size of the riparian areas continues to be downward, especially in those spring areas that seemed to have lost water (some of the field notes and data suggest the water may have increased in them between July and October 2004). Increase cattle use again, may have played a important role in the change.

The above statements and results may be preliminary and inconclusive but they are trends nonetheless. The future planned studies should provide a more complete view of what changes, if any, have occurred in the riparian communities in the East Fork and Main Fork of Box Canyon.

RIPARIAN COMPLEX DATA SHEET
October 2004

CLIENT: Canyon Fuel Company

COMPLEX: Number EFB-1

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: September 29 - October 3, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: West

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~1°

ELEVATION: 8,410ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Aspen Right: Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data resultsfor this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 1200 lbs./acre

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Salix sp.*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides	*Potentilla fruticosa*		*Carex lanuginosa*
	Rosa woodsii		*Juncus ensifolius*
			Juncus arcticus
			Poa pratensis

POOL ATTRIBUTES (meadow, no well defined stream channel)

% area in pools: 0

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 0

% bank length with overhanging vegetation: 0

BANK CONDITION

% bank length vegetated, stable: 90

% bank length unvegetated, stable: 10

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many of the sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) This was a meadow area, not a stream.
2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 27 ft. transect on left side; 33 ft. transect on right side.
3) Heavy grazing by cattle this year. Because of this some plant identifications were difficult.

DATA SUMMARIES

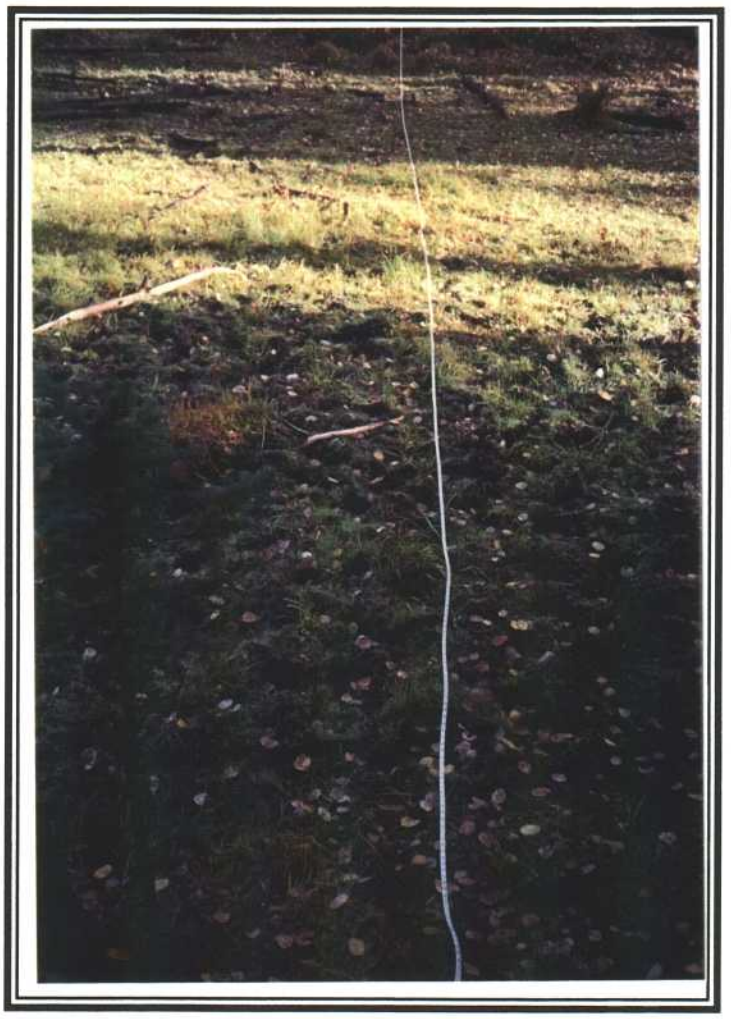
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-1		Left	25.5	*Carex lanuginosa/Agrostis stolonifera*
		Right	25.5	*Carex lanuginosa/Agrostis stolonifera*
		Channel	n/a	Dry (no standing water)

EFB-1: Cover using point quadrats (October 2004).

COVER BY SPECIES	Percent
TREES & SHRUBS	
FORBS	
GRASSES OR GRASS-LIKES	
Agrostis stolonifera	15.79
Carex lanuginosa	47.37
TOTAL COVER	
LIVING COVER (vascular)	63.13
WATER	0.00
MOSS	0.00
LITTER	15.79
BAREGROUND	21.05
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-1

RIPARIAN COMPLEX DATA SHEET
October 2004

CLIENT: Canyon Fuel Company

COMPLEX: Number EFB-2

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: September 29-October 3, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: WNW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~1-2^{o}

ELEVATION: 8,380 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen/Sagebrush Right: Aspen/Sagebrush

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 800 lbs./ac

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, ATV, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Pinus ponderosa	*Artemisia tridentata*	*Aster sp.*	*Juncus arcticus*
Populus tremuloides	*Potentilla fruticosa*	*Lepidium latifolium*	*Poa secunda*
		Taraxacum officinale	*Poa pratensis*
			Juncus longistylis
			Carex lanuginosa

POOL ATTRIBUTES (meadow, no well defined stream channel)

% area in pools: 0

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 80

% bank length with overhanging vegetation: 0

BANK CONDITION

% bank length vegetated, stable: 50

% bank length unvegetated, stable: 50

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many of the sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) This was a meadow area, not a stream.
2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side.
3) Heavy grazing by cattle this year. Vegetation was eaten close to the soil surface. Because of this some plant identifications were difficult.

DATA SUMMARIES

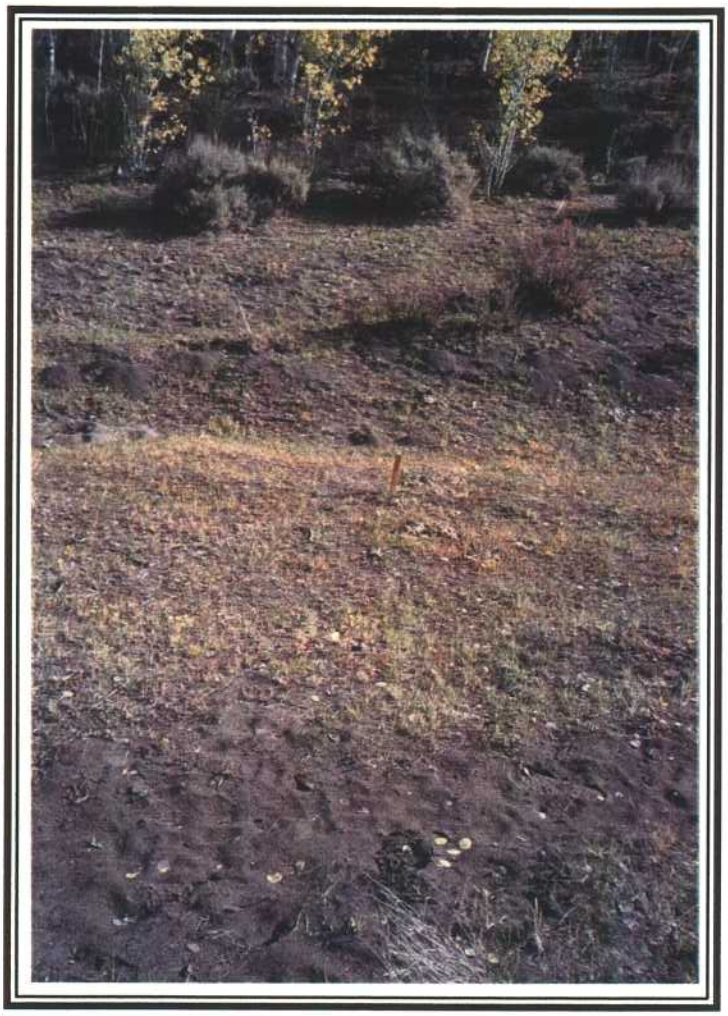
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-2		Left	14.0	*Agrostis stolonifera/Poa pratensis*
		Right	14.0	*Agrostis stolonifera/Poa pratensis*
		Channel	n/a	Dry

EFB-2: Cover using point quadrats (October 2004).

COVER BY SPECIES	Percent
TREES & SHRUBS	
FORBS	
Achillea millefolium	6.25
GRASSES OR GRASS-LIKES	
Agrostis stolonifera	6.25
Carex lanuginosa	6.25
TOTAL COVER	
LIVING COVER (vascular)	18.75
WATER	0.00
MOSS	0.00
LITTER	37.50
BAREGROUND	43.75
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-2

RIPARIAN COMPLEX DATA SHEET
October 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-3

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: September 29-October 3, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: NW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,360 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen Right: Aspen/Ponderosa Pine

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 500 lbs./ac

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Pinus ponderosa	*Artemisia tridentata*	*Equisetum arvense*	*Agrostis stolonifera*
Populus tremuloides		*Lepidium latifolia*	*Carex lanuginosa*
		Lupinus sp.	*Juncus ensifolius*
		Taraxacum officinale	*Juncus arcticus*
		Eriogonum sp.	*Poa fendleriana*

POOL ATTRIBUTES

% area in pools: n/a (no water in the channel at this location)
% pool area made up of pools > 2' deep: n/a (no water in the channel at this location)

AQUATIC VEGETATION

% streambed with filamentous algae: n/a (no water in the channel at this location)
% stream margin with rooted aquatic: n/a (no water in the channel at this location)

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0
% bank length gently sloping (>135°):
% bank length with overhanging vegetation: 0

BANK CONDITION

% bank length vegetated, stable: 95
% bank length unvegetated, stable: 5
% bank length vegetated, unstable: 0
% bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side. (1 ft. bare stream area).
2) Heavy grazing by cattle this year. Because of this some plant identifications were difficult.
3) Cattle trail in left side of riparian vegetation may influence greenline measurements.

DATA SUMMARIES

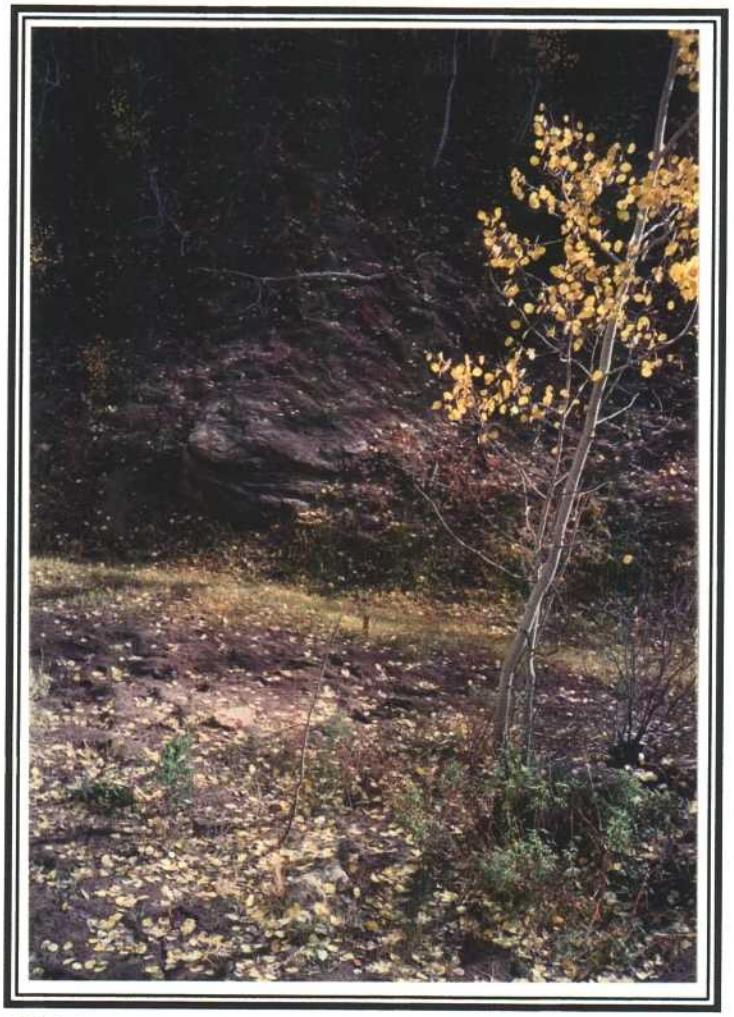
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-3		Left	4.0	*Agrostis stolonifera/Juncus arcticus*
		Right	4.0	*Agrostis stolonifera/Juncus arcticus*
		Channel	n/a	Dry

EFB-3: Cover using point quadrats (October 2004).

COVER BY SPECIES	Percent
TREES & SHRUBS	
FORBS	
Eriogonum sp.	6.25
GRASSES OR GRASS-LIKES	
Agrostis stolonifera	6.25
Poa pratensis	12.50
Carex lanuginosa	12.50
TOTAL COVER	
LIVING COVER (vascular)	37.50
WATER	0.00
MOSS	0.00
LITTER	18.75
BAREGROUND	37.50
ROCK	6.25
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-3

RIPARIAN COMPLEX DATA SHEET
October 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-4

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: September 29-October 3, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~3°

ELEVATION: 8,355 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Ponderosa Pine/Aspen Right: Aspen/Ponderosa Pine

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 300 lbs./ac

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Artemisia tridentata*	*Epilobium angustifolium*	*Agrostis stolonifera*
Populus tremuloides	*Chrysothamnus nauseosus*	*Antennaria sp.*	*Carex lanuginosa*
Pinus ponderosa	*Potentilla fruticosa*		*Bromus carinatus*
	Rosa woodsii		*Juncus arcticus*
			Poa fendleriana
			Juncus longistylis

POOL ATTRIBUTES

% area in pools: 60

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 5 (dry trail)

% bank length with overhanging vegetation: 5

BANK CONDITION

% bank length vegetated, stable: 40

% bank length unvegetated, stable: 30

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 30

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side (1 ft. water).

2) Heavy grazing by cattle this year. Because of this some plant identifications were difficult.

DATA SUMMARIES

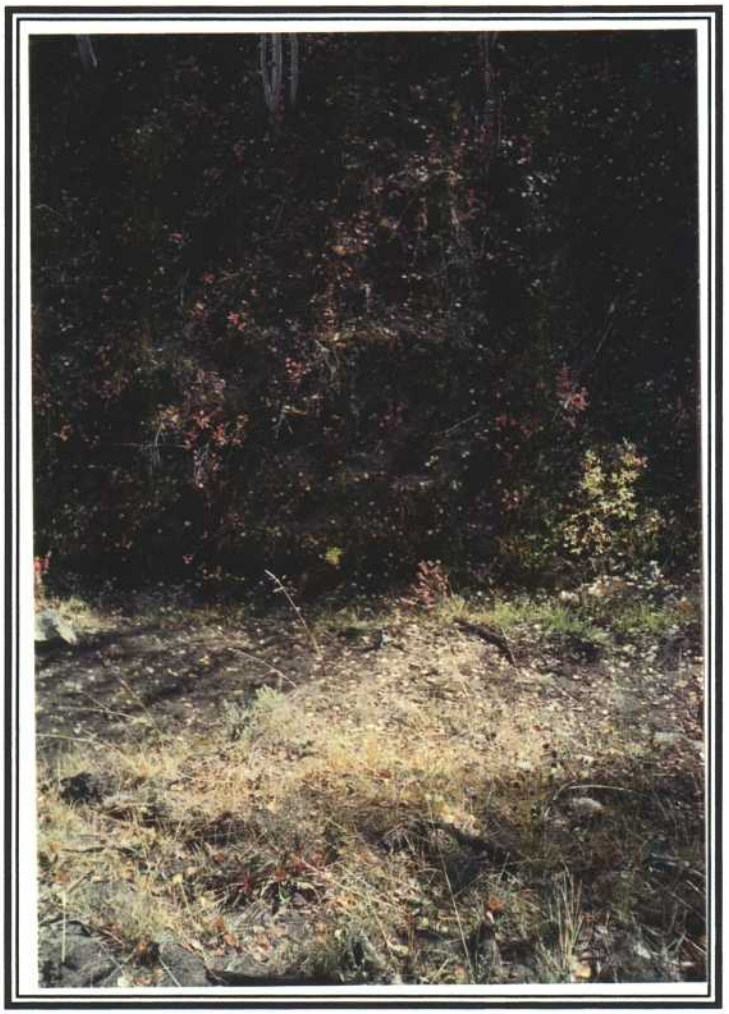
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-4		Left	3.5	*Agrostis stolonifera/Poa fendleriana*
		Right	1.0	*Agrostis stolonifera/Juncus arcticus*
		Channel	2.5	Water

EFB-4: Cover using point quadrats (October 2004).

COVER BY SPECIES	Percent
TREES & SHRUBS	
Rosa woodsii	6.25
Symphoricarpos oreophilus	6.25
FORBS	
GRASSES OR GRASS-LIKES	
Agrostis stolonifera	6.25
Poa fendleriana	18.75
TOTAL COVER	
LIVING COVER (vascular)	37.50
WATER	6.25
MOSS	0.00
LITTER	25.00
BAREGROUND	31.25
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-4

RIPARIAN COMPLEX DATA SHEET
October 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-5

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: September 29-October 3, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,320 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen Right: Ponderosa Pine/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: moderately stable

ESTIMATED FORAGE PRODUCTION: 200 lbs./ac

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Artemisia tridentata*	*Achillea millefolium*	*Agrostis stolonifera*
Populus tremuloides	*Potentilla fruticosa*	*Epilobium angustifolium*	*Poa fendleriana*
Pinus ponderosa	*Rosa woodsii*		*Stipa hymenoides*
	Symphoricarpos oreophilus		*Carex lanuginosa*

POOL ATTRIBUTES

% area in pools: n/a (no water in this area)
% pool area made up of pools > 2' deep: n/a (no water in this area)

AQUATIC VEGETATION

% streambed with filamentous algae: n/a (no water in this area)
% stream margin with rooted aquatic: n/a (no water in this area)

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0
% bank length gently sloping (>135°): 0 (but close to 135°)
% bank length with overhanging vegetation: 1%

BANK CONDITION

% bank length vegetated, stable: 35
% bank length unvegetated, stable: 65
% bank length vegetated, unstable: 0
% bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Side slopes (above bankfull) were very unstable.
2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side (1.25 ft. of sandy bottom).
3) No water in channel in this location.
4) Heavy grazing by cattle this year. Because of this some plant identifications were difficult.

DATA SUMMARIES

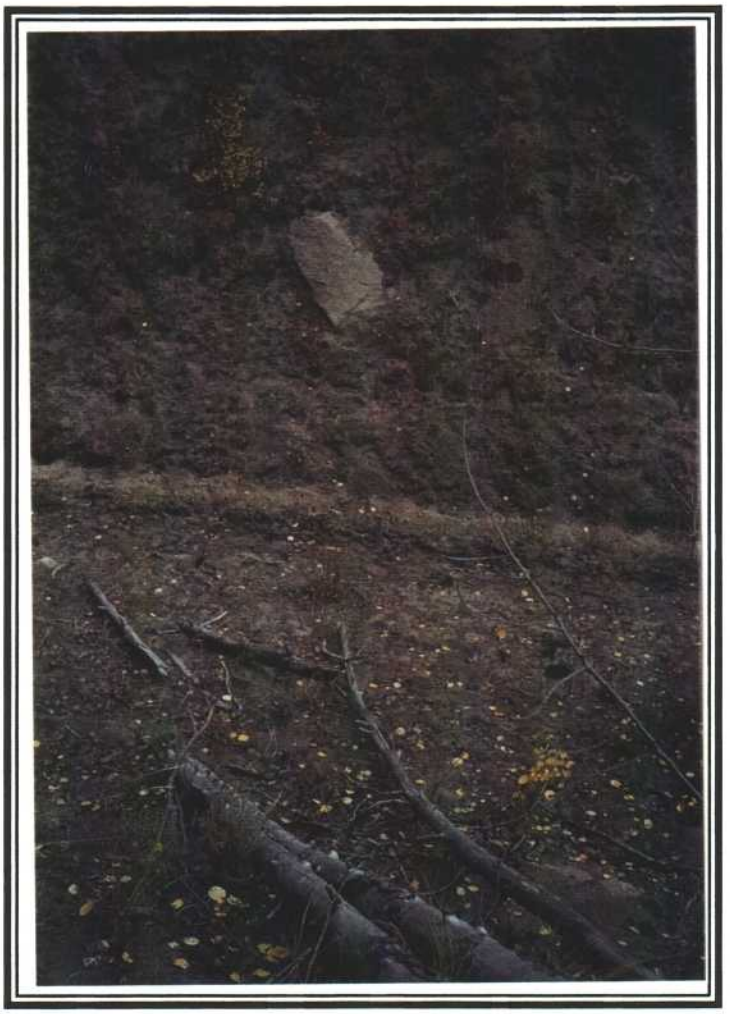
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-5		Left	2.0	*Agrostis stolonifera*
		Right	2.0	*Agrostis stolonifera*
		Channel	n/a	Dry

EFB-5: Cover using point quadrats (October 2004).

COVER BY SPECIES	Percent
TREES & SHRUBS	
Rosa woodsii	6.25
FORBS	
GRASSES OR GRASS-LIKES	
Poa fendleriana	12.50
TOTAL COVER	
LIVING COVER (vascular)	18.75
WATER	0.00
MOSS	0.00
LITTER	37.50
BAREGROUND	37.50
ROCK	6.25
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-5

RIPARIAN COMPLEX DATA SHEET
October 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-6

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: September 29-October 3, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,280 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
  - Scout Family Soils: 35 %
  - Doney Family Soils: 25%
  - Guben Family Soils: 25%
  - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen/Ponderosa Pine Right: Pinus ponderosa/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 150 lbs./ac

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Amelanchier utahensis*	*Taraxacum officinale*	*Agrostis stolonifera*
Populus tremuloides	*Potentilla fruticosa*	*Antennaria sp.*	*Bromus carinatus*
Pinus ponderosa	*Symphoricarpos oreophilus*	*Aster sp.*	*Juncus arcticus*
Populus fremontii	*Artemisia tridentata*	*Swertia radiata*	*Poa fendleriana*
		Artemisia ludoviciana	

POOL ATTRIBUTES

% area in pools: 20

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 30

% bank length gently sloping (>135°): (trail)

% bank length with overhanging vegetation: 10

BANK CONDITION

% bank length vegetated, stable: 25

% bank length unvegetated, stable: 35

% bank length vegetated, unstable: 5

% bank length unvegetated, unstable: 35

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Side slope banks above bankfull unstable
2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side (2.5 ft. of water).
3) Heavy grazing by cattle this year. Because of this some plant identifications were difficult.
4) Cattle trail was on some of the riparian community and could affect results.

DATA SUMMARIES

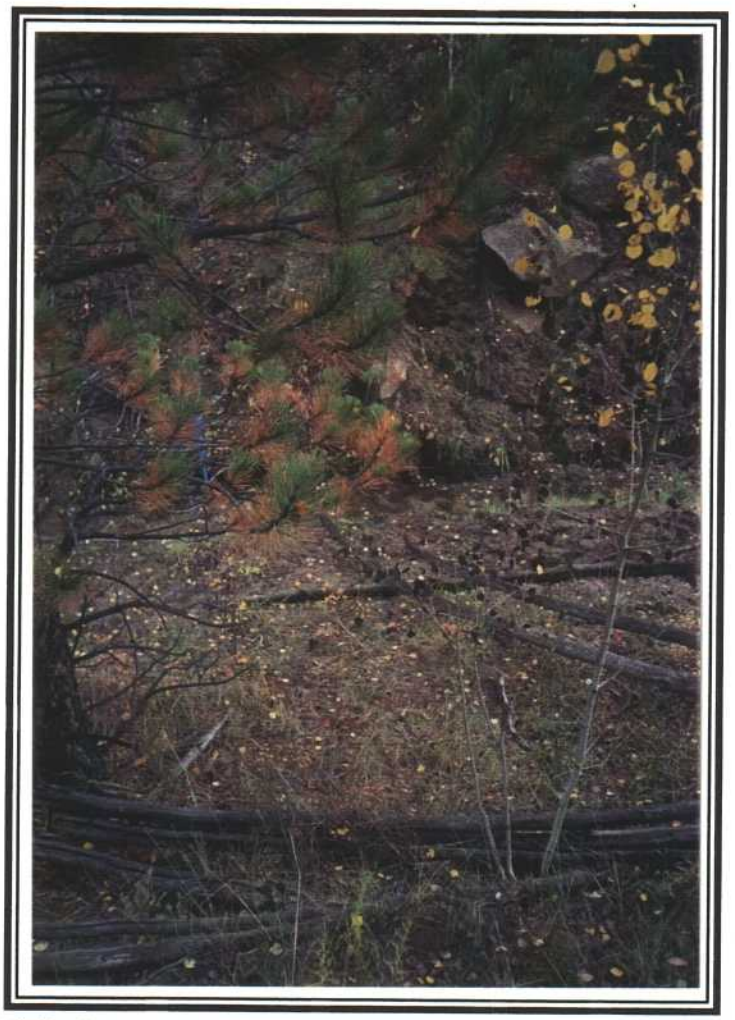
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-6		Left	2.0	*Agrostis stolonifera*
		Right	2.0	*Agrostis stolonifera*
		Channel	2.0	Water

EFB-6: Cover using point quadrats (October 2004).

COVER BY SPECIES	Percent
TREES & SHRUBS	
FORBS	
Taraxacum officinale	12.50
GRASSES OR GRASS-LIKES	
Poa fendleriana	12.50
Carex lanuginosa	6.25
TOTAL COVER	
LIVING COVER (vascular)	31.25
WATER	0.00
MOSS	0.00
LITTER	6.25
BAREGROUND	0.00
ROCK	62.50
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-6

RIPARIAN COMPLEX DATA SHEET
October 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-7

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: September 29-October 3, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: NNW

VALLEY BOTTOM TYPE: I or II

STREAM GRADIENT: ~2°

ELEVATION: 8,270 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
  - Scout Family Soils: 35 %
  - Doney Family Soils: 25%
  - Guben Family Soils: 25%
  - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen/Spruce Right: Aspen/Spruce

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 100 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Juniperus communis*	*Aster sp.*	*Agrostis stolonifera*
Populus tremuloides			*Juncus longistylis*
			Poa fendleriana

POOL ATTRIBUTES

% area in pools: 25

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 100 until steep, unstable, upper banks, then 0.

% bank length with overhanging vegetation: 2

BANK CONDITION

% bank length vegetated, stable: 35

% bank length unvegetated, stable: 65

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Low species diversity.
2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side (1.0 ft. water, 1.5 ft. rock).
3) Very unstable upper banks (above bankfull).
4) Heavy grazing by cattle this year. Because of this some plant identifications were difficult
5) Right side was sloughing off; no green area.

DATA SUMMARIES

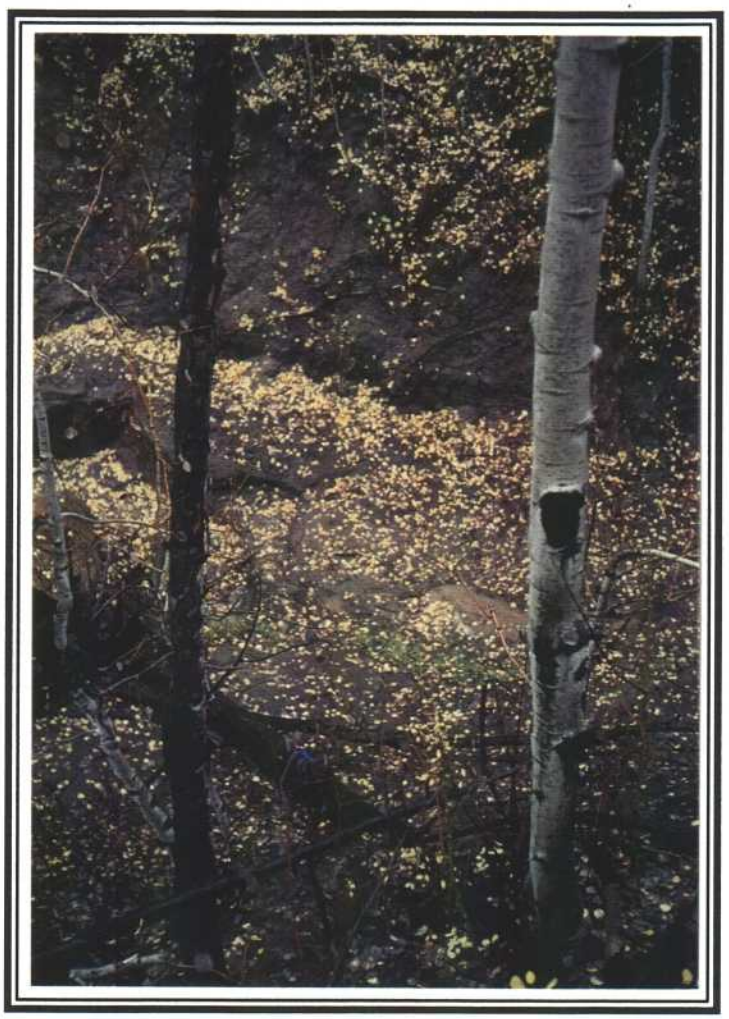
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-7		Left	3.0	*Agrostis stolonifera*
		Right	0	bareground
		Channel	1.5	Water

EFB-7: Cover using point quadrats (October 2004).

COVER BY SPECIES	Percent
TREES & SHRUBS	
FORBS	
GRASSES OR GRASS-LIKES	
Poa fendleriana	12.50
Carex lanuginosa	6.25
TOTAL COVER	
LIVING COVER (vascular)	18.75
WATER	6.25
MOSS	0.00
LITTER	37.50
BAREGROUND	25.00
ROCK	12.50
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-7

RIPARIAN COMPLEX DATA SHEET
October 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-8

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: September 29-October 3, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: NNW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,265 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
  - Scout Family Soils: 35 %
  - Doney Family Soils: 25%
  - Guben Family Soils: 25%
  - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Aspen Right: Aspen/Spruce

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 300 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Symphoricarpos oreophilus*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides		*Achillea millefolium*	*Carex lanuginosa*
Pinus ponderosa		*Penstemon sp.*	*Juncus arcticus*
		Antennaria sp.	*Bromus japonicus*
		Equisetum arvensis	*Poa fendleriana*
		Potentilla sp.	

POOL ATTRIBUTES

% area in pools: 15

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 40

% bank length with overhanging vegetation: 20

BANK CONDITION

% bank length vegetated, stable: 45

% bank length unvegetated, stable: 45

% bank length vegetated, unstable: 5

% bank length unvegetated, unstable: 5

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Beginning to see more blue spruce and less ponderosa pine in uplands in this area.

2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 12 ft. transect on left side (rock ledge after 12 ft.); 33 ft. transect on right side (7 ft sand/mud plus 4 ft water).

3) Heavy grazing by cattle this year. Because of this some plant identifications were difficult.

4) There was a spring in this area near the stream. Right transect crossed thespring community too. I counted the "island" between the two as riparian.
5) The stream water width was about 1 ft. There was somewhat less than this in the spring.

DATA SUMMARIES

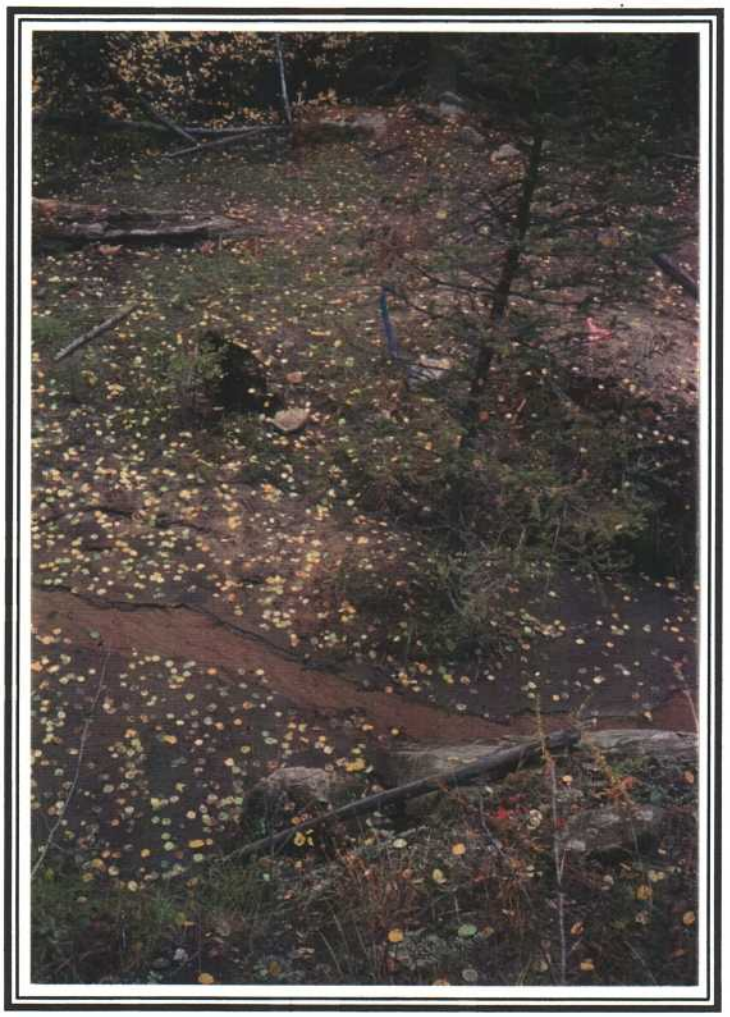
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-8		Left	1.0	*Agrostis stolonifera*
		Right	19.0	*Agrostis stolonifera* (includes spring area)
		Channel	8.0	Mud (see note for measurements)

EFB-8: Cover using point quadrats (October 2004).

COVER BY SPECIES	Percent
TREES & SHRUBS	
FORBS	
Achillea millefolium	5.56
GRASSES OR GRASS-LIKES	
Agrostis stolonifera	11.11
Poa pratensis	11.11
LIVING COVER (vascular)	27.78
WATER	11.11
MOSS	0.00
LITTER	27.78
BAREGROUND	27.78
ROCK	5.56
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-8

RIPARIAN COMPLEX DATA SHEET
October 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-9 (RE-10)

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: September 29-October 3, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss/Blackhawk Fm

ASPECT: W

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~3°

ELEVATION: 8,240 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
  - Scout Family Soils: 35 %
  - Doney Family Soils: 25%
  - Guben Family Soils: 25%
  - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen Right: Spruce/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: moderately stable

ESTIMATED FORAGE PRODUCTION: 100

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Rosa woodsii*	*Equisetum arvensis*	*Agrostis stolonifera*
Populus tremuloides	*Symphoricarpos oreophilus*	*Ranunculus cymbalaria*	
Salix amygdaloides			

POOL ATTRIBUTES

% area in pools: 35

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 0

% bank length with overhanging vegetation: 35

BANK CONDITION

% bank length vegetated, stable: 30

% bank length unvegetated, stable: 35

% bank length vegetated, unstable: 5

% bank length unvegetated, unstable: 30

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable (left side)/unstable (right side)

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Bank cut on right side.
2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side (plus 1 ft. mud and 1.5 ft water).

   In addition, the USDA Forest Service Protocol for Level III was employed by measuring the plant communities using the line intercept method.
3) Photo taken from right side.
4) Heavy grazing by cattle this year. Because of this some plant identifications were difficult.
5) For point quadrats we had different transect lengths for July 04 (50 ft) and Oct 04 (38 ft). This is probably because there were two transects marked in the field because we also utilized transects from our 1999 study which were different than the one's marked by the team for the more recent studies.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-9	RE-10	Left	1.5	*Agrostis stolonifera*
		Right	1.0	*Agrostis stolonifera/Geranium richardsoinn*
		Channel	2.0	Water 1.0; Dry 1.0

EFB-9 (RE-10): Cover using point quadrats (October 2004).

COVER BY SPECIES	Percent
TREES & SHRUBS	
FORBS	
Antennaria microphylla	7.69
GRASSES OR GRASS-LIKES	
Agrostis stolonifera	15.38
TOTAL COVER	
LIVING COVER (vascular)	23.07
WATER	7.69
MOSS	38.46
LITTER	23.08
BAREGROUND	0.00
ROCK	7.69
TOTAL	100.00

Cover by Community Types - EFB-9 (RE-10)
USDA Forest Service Protocol (1992)

UPLAND VEGETATION

Populus tremuloides/Picea pungens	15.50
Populus tremuloides/Rosa woodsii	12.00

RIPARIAN VEGETATION

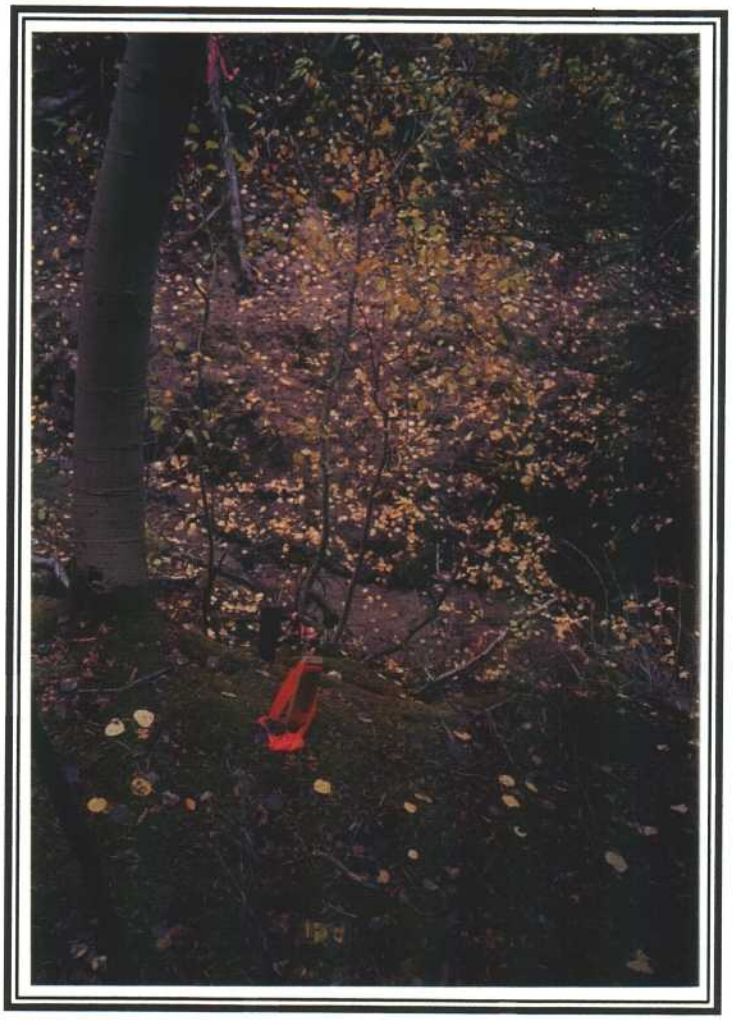
Dominant Woody Species

Dominant Herbaceous Species

Agrostis stolonifera	2.50

TOTAL COVER (Upland Species)	27.50
TOTAL COVER (Riparian Species)	2.50
BAREGROUND	0.00
DRY BOTTOM	1.00
STREAM (water width)	1.00
TOTAL COVER	32.00

PHOTOGRAPHIC DOCUMENTATION



EFB-9 (RE-10)

RIPARIAN COMPLEX DATA SHEET
October 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-10 (RE-09)

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: September 29-October 3, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Blackkhawk

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~3°

ELEVATION: 8,120 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
  - Scout Family Soils: 35 %
  - Doney Family Soils: 25%
  - Guben Family Soils: 25%
  - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

MORE SOILS INFORMATION:

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce Right: Spruce/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 150 lbs./ac

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Salix sp.*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides	*Rosa woodsii*	*Geranium richardsonii*	
Betula occidentalis		*Equisetum arvense*	
Salix sp.		*Epilobium angustifolium*	

POOL ATTRIBUTES

% area in pools: 20

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 5

% bank length gently sloping (>135°): 50

% bank length with overhanging vegetation: 30

BANK CONDITION

% bank length vegetated, stable: 35

% bank length unvegetated, stable: 60

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 5

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Just beginning to see river birch in this area.
2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 12 ft. transect on right side until rock ledge (plus 2.5 ft. of water).
   In addition, the USDA Forest Service Protocol for Level III was employed by measuring the plant communities using the line intercept method.
3) Left hillside suggests (by presence of horsetail) that there is probably a lot of soil moisture in the spring and early summer. No water in hillside observed
4) Waterfall is below this station.
5) Photo taken from left side.
6) Heavy grazing by cattle this year. Because of this some plant identifications were difficult.
7) There was lots of bareground that I counted in the upland community.
8) For point quadrats we had different transect lengths for July 04 (50 ft) and Oct 04 (28 ft). This is probably because there were two transects marked in the field because we also utilized transects from our 1999 study which were different than the one's marked by the team for the more recent studies.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-10	RE-09	Left	1.0	*Agrostis stolonifera*
		Right	2.0	*Agrostis stolonifera/Equisetum arvense*
		Channel	1.0	Water

EFB-10 (RE-9): Cover using point quadrats (October 2004).

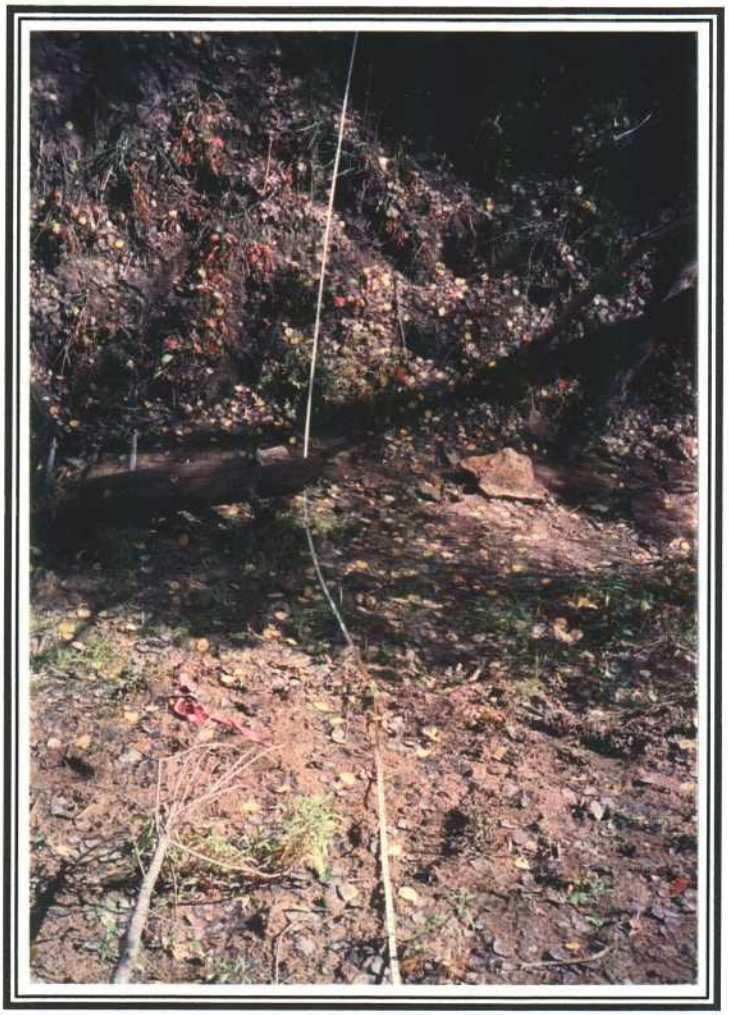
COVER BY SPECIES	Percent
TREES & SHRUBS	
FORBS	
Taraxacum officinale	22.22
Achillea millefolium	11.11
GRASSES OR GRASS-LIKES	
Agrostis stolonifera	11.11
TOTAL COVER	
LIVING COVER (vascular)	44.44
WATER	11.11
MOSS	0.00
LITTER	22.22
BAREGROUND	22.22
ROCK	0.00
TOTAL	100.00

Cover by Community Types - RE-09 (EFB-10)

USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Picea pungens	15.00
Populus tremuloides/Picea pungens	9.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera	1.00
Agrostis stolonifera/Geranium richardsonii	2.00
TOTAL COVER (Upland Species)	24.00
TOTAL COVER (Riparian Species)	3.00
BAREGROUND	0.00
ROCK	0.00
STREAM (water width)	1.00
TOTAL COVER	28.00

PHOTOGRAPHIC DOCUMENTATION



EFB-10 (RE-09)

RIPARIAN COMPLEX DATA SHEET
October 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-11

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: September 29-October 3, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Fm

ASPECT: NW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~3°

ELEVATION: 8,120 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
  - Scout Family Soils: 35 %
  - Doney Family Soils: 25%
  - Guben Family Soils: 25%
  - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

MORE SOILS INFORMATION:

- Soil Map Unit No. 20
- Family: Strych
- Composition:
  - Strych Family Soils: 30 %
  - Pathead Family Soils: 30%
  - Podo Family Soils: 15%
  - Rubbleland: 15%
  - Contrasting inclusions of rock outcrops, and finer textured soils: 10%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Aspen Right: Spruce/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 300 lbs/ac. (including woody species)

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Pachystima myrsinites*	*Cirsium sp.*	*Agrostis stolonifera*
Populus tremuloides	*Symphoricarpos oreophilus*	*Geranium richardsonii*	*Juncus longistylis*
Salix sp.		*Equisetum arvense*	*Poa fendleriana*
Cornus sericea			
Betula occidentalis			

POOL ATTRIBUTES

% area in pools: 35

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 0

% bank length with overhanging vegetation: 35-40

BANK CONDITION

% bank length vegetated, stable: 40

% bank length unvegetated, stable: 50

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 10

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) This site is just below the confluence of a spring (EFB-S1)
2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 18 ft. transect on left side; 24 ft. transect on right side (plus 3 ft. water and 2 ft rock).
3) Heavy grazing by cattle this year. Because of this some plant identifications were difficult.

DATA SUMMARIES

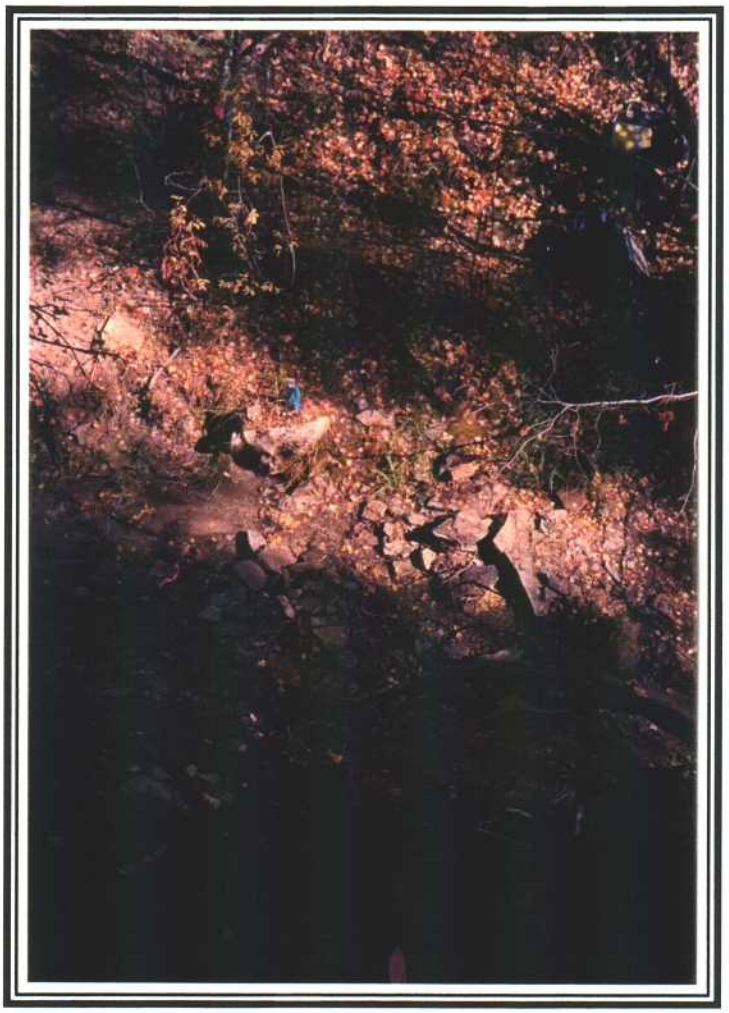
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-11		Left	1.0	*Equisetum arvense/Geranium richardsonii*
		Right	5.0	*Geranium richardsonii/Agrostis stolonifera*
		Channel	?	

EFB-11: Cover using point quadrats (October 2004).

COVER BY SPECIES	Percent
TREES & SHRUBS	
FORBS	
Geranium richardsonii	6.67
Equisetum arvense	6.67
GRASSES OR GRASS-LIKES	
Agrostis stolonifera	6.67
TOTAL COVER	
LIVING COVER (vascular)	20.01
WATER	6.67
MOSS	6.67
LITTER	33.33
BAREGROUND	13.33
ROCK	20.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-11

RIPARIAN COMPLEX DATA SHEET
October 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-S1

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: September 29-October 3, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Fm

ASPECT: W

VALLEY BOTTOM TYPE: II

STREAM (SLOPE) GRADIENT: ~28°

ELEVATION: 8,120 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 20
- Family: Strych
- Composition:
  - Strych Family Soils: 30 %
  - Pathead Family Soils: 30%
  - Podo Family Soils: 15%
  - Rubbleland: 15%
  - Contrasting inclusions of rock outcrops, and finer textured soils: 10%

MORE SOILS INFORMATION:

- Soil Map Unit No. 107
- Family: Scout
- Composition:
  - Scout Family Soils: 35 %
  - Doney Family Soils: 25%
  - Guben Family Soils: 25%
  - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Aspen Right: Spruce/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 400 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Salix sp.*	*Equisetum arvense*	*Agrostis stolonifera*
Populus tremuloides		*Ranunculus cymbalaria*	*Carex lanuginosa*
	Symphoricarpos oreophilus	*Aster sp.*	*Elymus trachycaulus*
			Juncus arcticus

POOL ATTRIBUTES

% area in pools: <2

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 30 (of wet area studied)

% bank length with overhanging vegetation: 10 (but increases above this area)

BANK CONDITION

% bank length vegetated, stable: 80

% bank length unvegetated, stable: 15

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 5 (left bank above green)

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) A spring area, it is located about 50 ft. above confluence with the main channel of East Fork of Box Canyon.
2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method.

3) I called the riparian community as 6 ft on the left and 6 ft on the right, but I could have added more because horsetail went about 7.5 ft more upslope (could be influenced by bank side groundwater).
4) There was not water cascading off rocks this sample period, but there was some surface water maintaining the riparian species at the station location.
5) Could not find the metal stakes marking sample area, so I monitored 10 ft of upland on each side.

DATA SUMMARIES

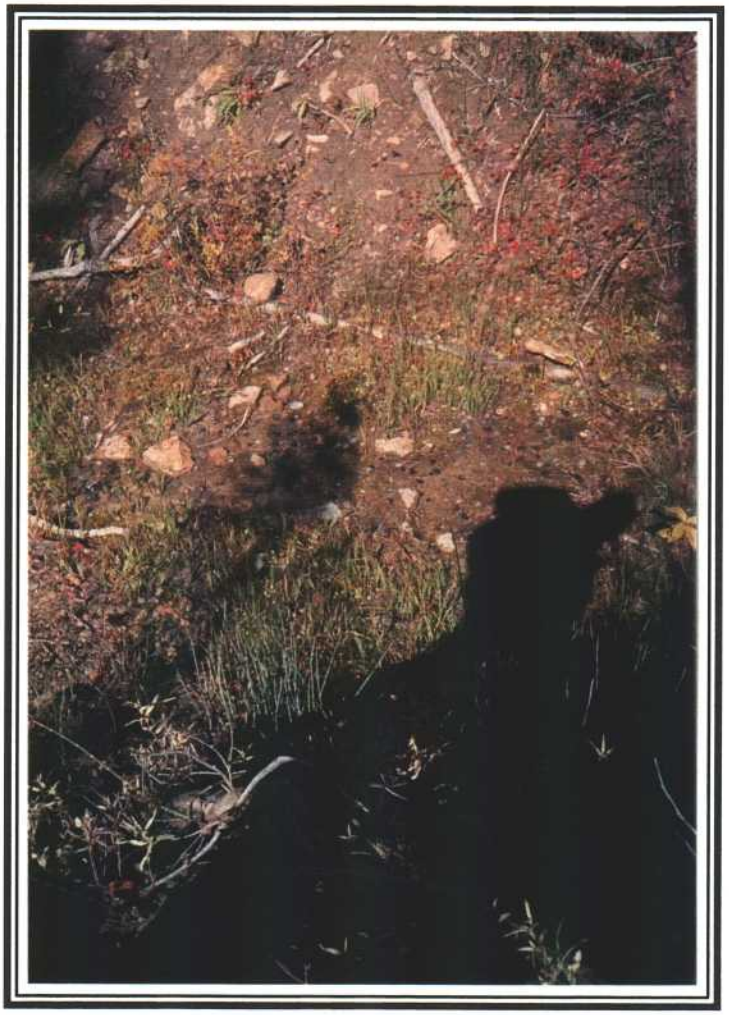
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-S1		Left	6.0	*Ranunculus cymbalaria/Equisetum arvense*
		Right	15.0+	*Geranium richardsonii/Equisetum arvense*
		Channel	2.0	Rock

Cover by Community Types - EFB-S1
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Aster/Bareground	10.00
Elymus trachycaulus	10.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Ranunculus cymbalaria/Equisetum arvense	6.0
Geranium richardsonii/Equisetum arvensis	15.00
TOTAL COVER (Upland Species)	20.00
TOTAL COVER (Riparian Species)	21.00
BAREGROUND	n/a
ROCK	n/a
STREAM (water width)	n/a
-	-
TOTAL COVER	41.00

PHOTOGRAPHIC DOCUMENTATION



EFB-S1

RIPARIAN COMPLEX DATA SHEET
October 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-S2 (EFB-12)

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: September 29-October 3, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss/Blackhawk Fm

ASPECT: W

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~30°

ELEVATION: 8,200 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
  - Scout Family Soils: 35 %
  - Doney Family Soils: 25%
  - Guben Family Soils: 25%
  - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

MORE SOILS INFORMATION:

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Picea pungens Right: Picea pungens

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 1,000 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Juniperus communis*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides		*Equisetum arvense*	*Carex lanuginosa*
Lonicera involucrata			
Betula occidentalis			

POOL ATTRIBUTES

% area in pools: 0

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 100

% bank length with overhanging vegetation: 65 (more below or downhill)

BANK CONDITION

% bank length vegetated, stable: 0

% bank length unvegetated, stable: 0

% bank length vegetated, unstable: 5

% bank length unvegetated, unstable: 95

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) This was an area that includes 2 springs near each other. Previous data (Oct. 2003) was taken at the head of the springs; water diffused downslope over a broad area in which data collection would have been difficult and possibly ambiguous.
2) The area was dry this sample period (Oct. 2004) due to a large sandstone cliff failure and rockslide over the entire spring area. A few riparian species remained, but not many. It's

basically an upland-looking community at this time.

3) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. I found both end stakes or the previous transect line. Green Line: Also measured on transects.
4) The cover measurement were taken where the old transect was, or 6 ft of *Carex lanuginosa*.
5) Some seeps may be beginning to form again below the sample area because riparian species such as *Carex lanuginosa* were beginning to show up.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-S2	EFB-12	Left	3.0	*Carex lanuginosa*
		Right	3.0	*Carex lanuginosa*
		Channel	n/a	

Cover by Community Types - EFB-S2

USDA Forest Service Protocol (1992)	(EFB-12)
-	-
UPLAND VEGETATION	
Populus tremuloides/Picea pungens	73.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Carex lanuginosa	6.00
TOTAL COVER (Upland Species)	73.00
TOTAL COVER (Riparian Species)	6.00
BAREGROUND	n/a
ROCK	n/a
STREAM (water width)	n/a
TOTAL COVER	79.00

RIPARIAN COMPLEX DATA SHEET
October 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-S3 - North & South (EFB-13)

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: September 29-October 3, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss/Blackhawk Fm

ASPECT: W

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2-30°

ELEVATION: 8,245 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
  - Scout Family Soils: 35 %
  - Doney Family Soils: 25%
  - Guben Family Soils: 25%
  - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

MORE SOILS INFORMATION:

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Ponderosa Pine Right: Ponderosa Pine

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 250 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Symphoricarpos oreophilus*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides	*Juniperus communis*	*Equisetum arvense*	*Elymus trachycaulus*
Pinus ponderosa	*Rosa woodsii*	*Geranium richardsonii*	
Salix amygdaloides			

POOL ATTRIBUTES

% area in pools: 100 in green line
% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0
% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0
% bank length gently sloping (>135°): 100
% bank length with overhanging vegetation: 60

BANK CONDITION

% bank length vegetated, stable: 10
% bank length unvegetated, stable: 90
% bank length vegetated, unstable: 0
% bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. Green Line: Also measured on these transects.

2) I found the found stakes. I measure north end and south end separately.
3) This spring area has gone dry.
4) Riparian species a present but they have decreased from Oct 2003.
5) There were wetland/riparian species i.e. buttercup and redtop (see Greenline data).
6) The understory in the area was mostly bareground.

DATA SUMMARIES

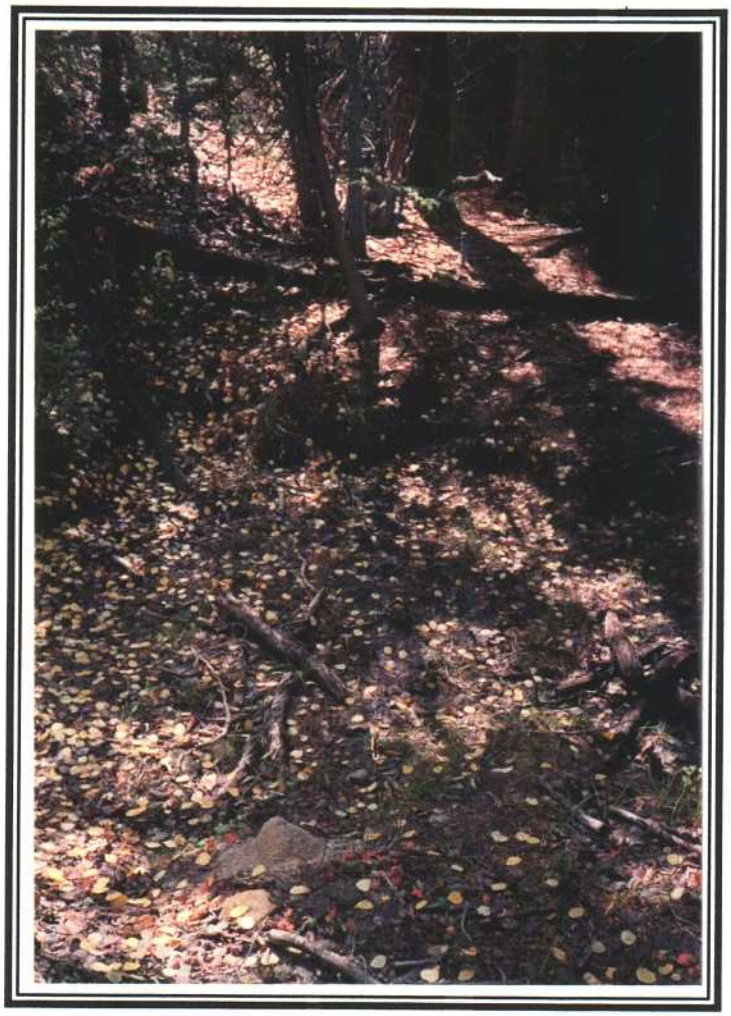
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-S3	EFB-13	North	2.0	*Agrostis stolonifera/Equisetum arvense*
		South	2.0	*Agrostis stolonifera/Equisetum arvense*
		Channel	n/a	

Cover by Community Types - EFB-S3

USDA Forest Service Protocol (1992)	(EFB-13)
-	-
UPLAND VEGETATION	
Picea pungens/Populus tremuloides	31.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Ranunculus cymbalaria	4.0
-	-
TOTAL COVER (Upland Species)	31.00
TOTAL COVER (Riparian Species)	4.00
BAREGROUND	26.00
ROCK	0.00
STREAM (water width)	0.00
-	-
TOTAL COVER	61.00

PHOTOGRAPHIC DOCUMENTATION



EFB-S3 (EFB-13)

RIPARIAN COMPLEX DATA SHEET
October 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-S4 (EFB-14)

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: September 29-October 3, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss/Blackhawk Fm

ASPECT: W

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~25°

ELEVATION: 8,240 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
  - Scout Family Soils: 35 %
  - Doney Family Soils: 25%
  - Guben Family Soils: 25%
  - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

MORE SOILS INFORMATION:

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Horsetail (uphill)/Spruce Right: Horsetail (uphill)/Spruce

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 500 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Symphoricarpos oreophilus*	*Geranium richardsonii*	
Populus tremuloides	*Potentilla fruticosa*	*Equisetum arvense*	
Salix amygdaloides	*Rosa woodsii*		

POOL ATTRIBUTES

% area in pools: 0

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 0

% bank length with overhanging vegetation: 65

BANK CONDITION

% bank length vegetated, stable: 45

% bank length unvegetated, stable: 55

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Spring area. There was a seep here last sample period (Oct 2003). It was dry leaving bareground for last sample period (Jul 2004). Some riparian species remain. The entire transect area was dominated by horsetail this period.
2) Judging by the plants, there may be some seepage beginning.

2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. Green Line: Also measured on these transects.

DATA SUMMARIES

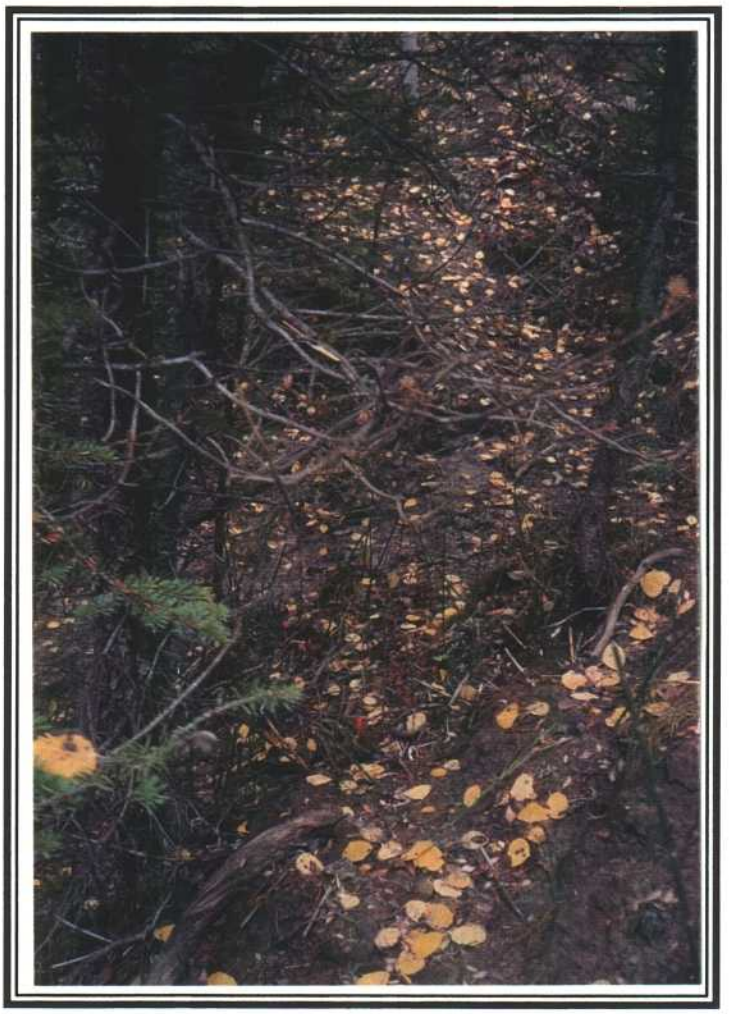
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-S4	EFB-14	Left	12.5	*Equisetum arvense*
		Right	12.5	*Equisetum arvense*
		Channel	n/a	

Cover by Community Types - EFB-S4

USDA Forest Service Protocol (1992)	(EFB-14)
UPLAND VEGETATION	
Picea pungens/Equisetum arvense	0.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Equisetum arvense	25.00
TOTAL COVER (Upland Species)	0.00
TOTAL COVER (Riparian Species)	25.00
BAREGROUND	0.00
ROCK	0.00
STREAM (water width)	0.00
TOTAL COVER	25.00

PHOTOGRAPHIC DOCUMENTATION



EFB-S4 (EFB-14)

RIPARIAN COMPLEX DATA SHEET
October 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number RE-11

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: September 29-October 3, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,265 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
  - Scout Family Soils: 35 %
  - Doney Family Soils: 25%
  - Guben Family Soils: 25%
  - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Wood's Rose/Aspen Right: Aspen/Spruce

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: no herbaceous lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Rosa woodsii*		
Populus tremuloides			

POOL ATTRIBUTES

% area in pools: 50

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 35

% bank length gently sloping (>135°): 30

% bank length with overhanging vegetation: 35

BANK CONDITION

% bank length vegetated, stable: 0

% bank length unvegetated, stable: 80

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 20

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): unstable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Sideslopes were noted as unstable last Fall 2003. The Spring 2004 sample period revealed that a large spruce tree had fallen directly in the sample area. The upland areas were unstable and movement of sample markers was observed. There were no riparian species in the transect area due to fallen tree and extensive cattle disturbance in Spring and Fall 2004.
2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. Green Line: Also measured on these transects.

DATA SUMMARIES

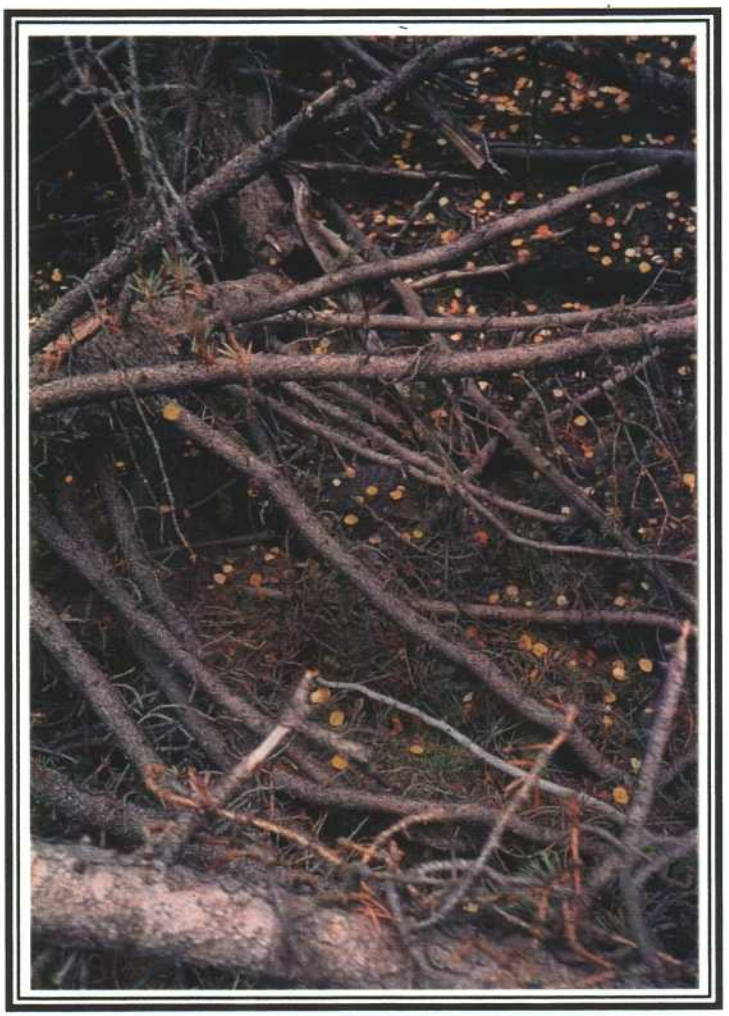
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
RE-11		Left	0.0	No riparian community (see notes)
		Right	0.0	No riparian community (see notes)
		Channel	4.0	Water

Cover by Community Types - RE-11
USDA Forest Service Protocol (1992)

-	-
UPLAND VEGETATION	
Populus tremuloides/Rosa woodsii	25.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera	0.00
-	-
TOTAL COVER (Upland Species)	25.00
TOTAL COVER (Riparian Species)	0.00
BAREGROUND	0.00
ROCK	0.00
STREAM (water width)	4.00
-	-
TOTAL COVER	29.00

PHOTOGRAPHIC DOCUMENTATION



RE-11

RIPARIAN COMPLEX DATA SHEET
October 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number RE-12

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: September 29-October 3, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,275 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
  - Scout Family Soils: 35 %
  - Doney Family Soils: 25%
  - Guben Family Soils: 25%
  - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%
  - o

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Sagebrush/Grass Right: Wood's Rose/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 500 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Populus tremuloides	*Salix sp.*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
	Artemisia tridentata	*Taraxacum officinale*	*Carex lanuginosa*
	Rosa woodsii	*Eriogonum sp.*	*Juncus longistylis.*
		Equisetum arvense	*Juncus arcticus*
			Poa secunda

POOL ATTRIBUTES

% area in pools: 10

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 50

% bank length with overhanging vegetation: 5

BANK CONDITION

% bank length vegetated, stable: 70

% bank length unvegetated, stable: 30

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Quantitative Methods:Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method.
2) The area looked more stable and better than the site upstream.
3) Photo taken from left side.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
RE-12		Left	5.0	*Agrostis stolonifera*
		Right	3.0	*Agrostis stoloniferaJuncus longistylis*
		Channel	2.0	Water

Cover by Community Types - RE-12
USDA Forest Service Protocol (1992)

-	-
UPLAND VEGETATION	
Artemisia tridentata/Poa secunda	10.00
Populus tremuloides/Rosa woodsii	10.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Juncus arcticus/Juncus longistylis	2.00
Agrostis stolonifera/Equisetum arvensis	6.00
-	-
TOTAL COVER (Upland Species)	20.00
TOTAL COVER (Riparian Species)	8.00
BAREGROUND	0.00
ROCK	0.00
STREAM (dry width)	2.00
-	-
TOTAL COVER	30.00

PHOTOGRAPHIC DOCUMENTATION

RE-12

RIPARIAN COMPLEX DATA SHEET
October 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number RE-13

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: September 29-October 3, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: NW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,315 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen Right: Aspen/Ponderosa Pine

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 150 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Artemisia tridentata*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides	*Potentilla fruticosa*	*Equisetum arvense*	*Carex lanuginosa*
Pinus ponderosa	*Symphoricarpos oreophilus*	*Artemisia dracunculus*	*Festuca ovina*
		Erigeron divergens.	*Juncus sp.*
		Achillea millefolium	*Elymus trachycaulus*
		Lupinus sp.	

POOL ATTRIBUTES

% area in pools: n/a (no water at this site)

% pool area made up of pools > 2' deep: n/a (no water at this site)

AQUATIC VEGETATION

% streambed with filamentous algae: n/a (no water at this site)

% stream margin with rooted aquatic: n/a (no water at this site)

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 0

% bank length with overhanging vegetation: 5

BANK CONDITION

% bank length vegetated, stable: 70

% bank length unvegetated, stable: 30

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Photo taken from right side.
2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method.
3) Site was dry.

DATA SUMMARIES

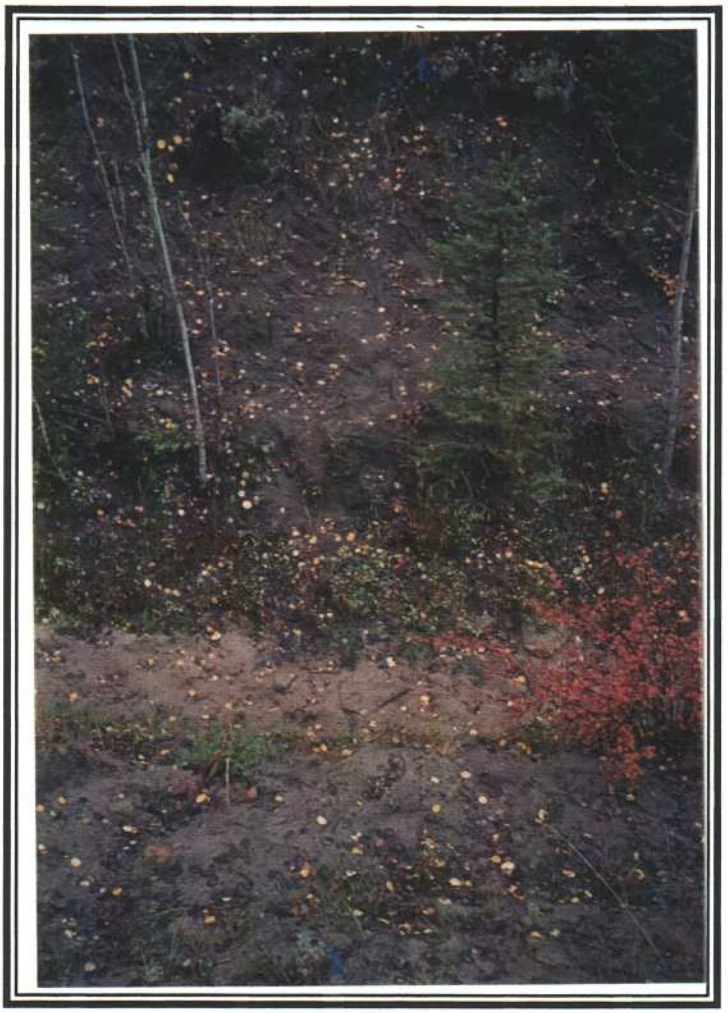
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
RE-13		Left	3.0	*Agrostis stolonifera/Ranunculus cymbalaria*
		Right	2.0	*Agrostis stolonifera/Ranunculus cymbalaria*
		Channel	2.0	Dry

Cover by Community Types - RE-13
USDA Forest Service Protocol (1992)

-	-
UPLAND VEGETATION	
Artemisia tridentata/Elymus trachycaulus	10.00
Populus tremuloides	12.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Ranunculus cymbalaria	5.00
-	-
TOTAL COVER (Upland Species)	22.00
TOTAL COVER (Riparian Species)	5.00
BAREGROUND	2.00
ROCK	0.00
STREAM (dry width)	2.00
-	-
TOTAL COVER	29.00

PHOTOGRAPHIC DOCUMENTATION



RE-13

RIPARIAN COMPLEX DATA SHEET
October 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-07

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: September 29-October 3, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: NW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,220 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Aspen Right: Aspen/Spruce

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 100 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Juniperus communis*	*Achillea millefolium*	*Agrostis stolonifera*
Populus tremuloides	*Potentilla fruticosa*	*Equisetum arvense*	*Carex lanuginosa*
Betula occidentalis		*Urtica dioica*	*Juncus longistylis*
		Artemisia ludoviciana	

POOL ATTRIBUTES

% area in pools: n/a (no water at this site)
% pool area made up of pools > 2' deep: n/a (no water at this site)

AQUATIC VEGETATION

% streambed with filamentous algae: n/a (no water at this site)
% stream margin with rooted aquatic: n/a (no water at this site)

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 25
% bank length gently sloping (>135°): 50
% bank length with overhanging vegetation: 35

BANK CONDITION

% bank length vegetated, stable: 30
% bank length unvegetated, stable: 30
% bank length vegetated, unstable: 0
% bank length unvegetated, unstable: 40

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable (left side); unstable (right side)

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Photo taken from the left side
2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method.

DATA SUMMARIES

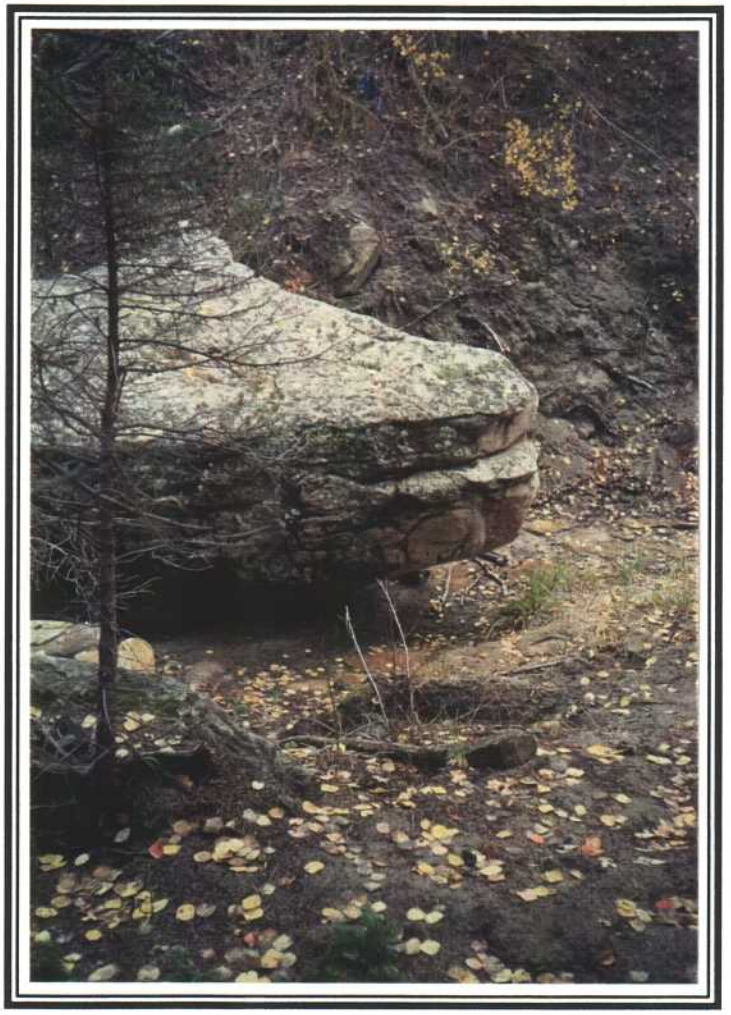
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-07		Left	1.0	*Agrostis stolonifera/Carex lanuginosa*
		Right	0.5	*Agrostis stolonifera/Carex lanuginosa*
		Channel	4.0	Rock

Cover by Community Types - R-07

USDA Forest Service Protocol (1992)	
UPLAND VEGETATION	
Picea pungens	
Populus tremuloides	10.00
	10.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Carex lanuginosa	1.50
TOTAL COVER (Upland Species)	20.00
TOTAL COVER (Riparian Species)	1.50
BAREGROUND	14.50
ROCK	4.00
STREAM (water width)	0.00
-	-
TOTAL COVER	40.00

PHOTOGRAPHIC DOCUMENTATION



R-07

RIPARIAN COMPLEX DATA SHEET
October 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-09

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: September 29-October 3, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,210 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Aspen Right: Aspen/Horsetail

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 400 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Salix lutea.*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides	*Artemisia tridentata*	*Equisetum arvense*	*Juncus longistylis*
Juniperus scopulorum	*Rosa woodsii*	*Urtica dioica*	

POOL ATTRIBUTES

% area in pools: 50

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 50

% bank length with overhanging vegetation: 50

BANK CONDITION

% bank length vegetated, stable: 80

% bank length unvegetated, stable: 10

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 10

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable (left side); moderately stable (right side)

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Photo taken from the left side.
2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method.
3) On the left side of the river there was about 8 ft wide area of redtop that it was uncertain where the water that supports it comes from (hillside seeps or stream).
4) The right side had hillside water influence.

DATA SUMMARIES

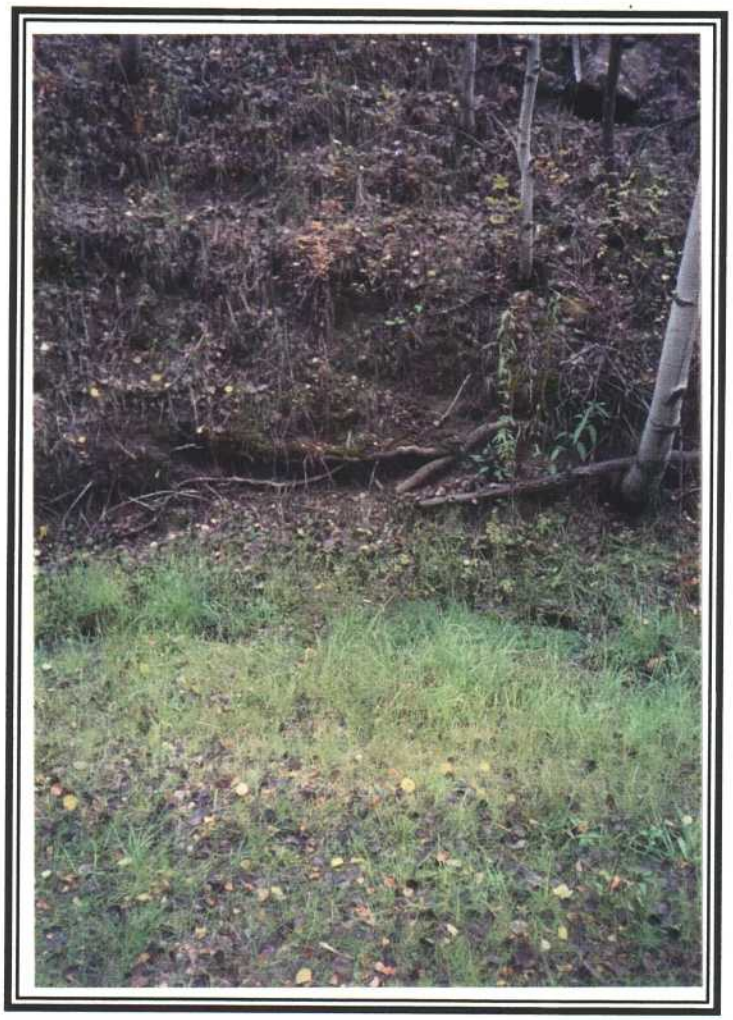
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-09		Left	13.5	*Agrostis stolonifera/Equisetum arvense/Juncus longistylis*
		Right	4.0	*Agrostis stolonifera/Ranunculus cymbalaria*
		Channel	0.5	Water

Cover by Community Types - R-9
USDA Forest Service Protocol (1992)

-	-
UPLAND VEGETATION	
Equisetum arvensis/Agrostis stolonifera (hillside)	11.50
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Ranunculus cymbalaria	4.00
Agrostis stolonifera/Equisetum arvensis	10.00
Juncus longistylis/Equisetum arvense	3.50
TOTAL COVER (Upland Species)	11.50
TOTAL COVER (Riparian Species)	17.50
BAREGROUND	0.00
ROCK	0.00
STREAM (water width)	0.50
-	-
TOTAL COVER	29.50

PHOTOGRAPHIC DOCUMENTATION



R-09

RIPARIAN COMPLEX DATA SHEET
October 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-11

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: September 29-October 3, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: NNW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,180 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Grass Right: Aspen/Wood's Rose

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 250 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Rosa woodsii*	*Epilobium angustifolium*	*Agrostis stolonifera*
Populus tremuloides		*Equisetum arvense*	*Juncus longistylis*
		Ranunculus cymbalaria	*Juncus arcticus*
			Poa secunda

POOL ATTRIBUTES

% area in pools: 50

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 40

% bank length gently sloping (>135°): 60

% bank length with overhanging vegetation: 10

BANK CONDITION

% bank length vegetated, stable: 60

% bank length unvegetated, stable: 20

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 20

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): moderately stable (left side); stable (right side)

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Photograph taken from the left side.
2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method.

DATA SUMMARIES

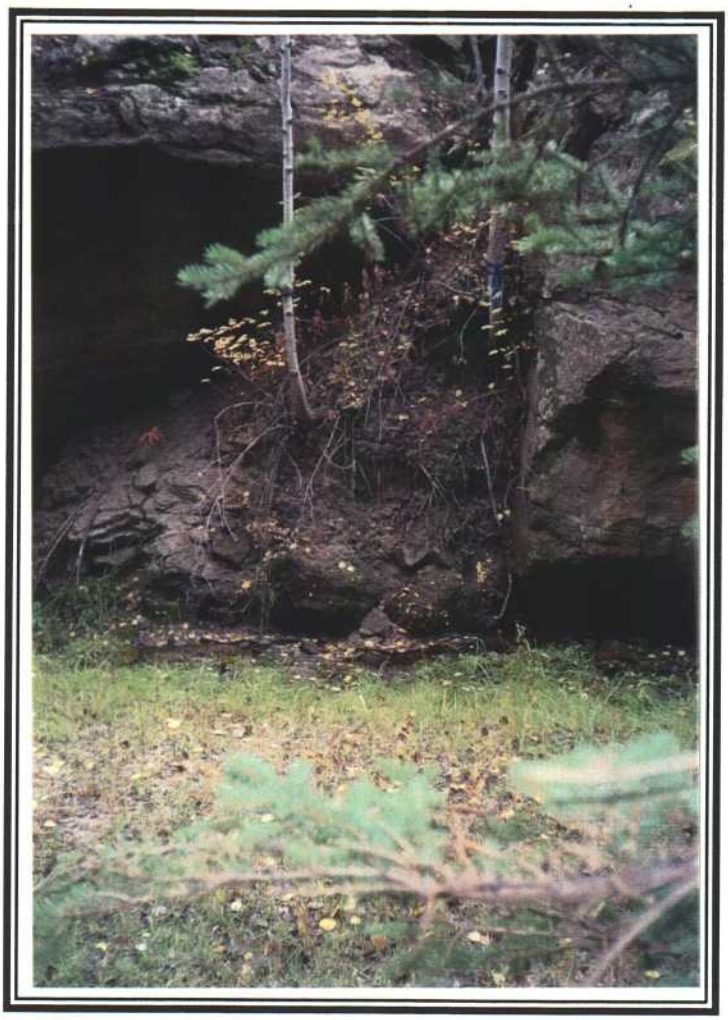
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-11		Left	11.0	*Equisetum arvense/Agrostis stolonifera/Juncus longistylis*
		Right	0	
		Channel	2.0	Water 1.5; moss 0.5

Cover by Community Types - R-11

USDA Forest Service Protocol (1992)	
UPLAND VEGETATION	
Picea pungens/Poa secunda	8.00
Populus tremuloides/Rosa woodsii	10.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Equisetum arvensis	5.00
Agrostis stolonifera/Juncus longistylis	3.00
Agrostis stolonifera	3.00
-	-
TOTAL COVER (Upland Species)	18.00
TOTAL COVER (Riparian Species)	11.00
BAREGROUND	0.00
MOSS	0.50
STREAM (water width)	1.50
TOTAL COVER	31.00

PHOTOGRAPHIC DOCUMENTATION



R-11

RIPARIAN COMPLEX DATA SHEET
October 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-13

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: September 29-October 3, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: NNW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,175 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce Right: Spruce/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: moderately stable

ESTIMATED FORAGE PRODUCTION: 300 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Potentilla fruticosa*	*Equisetum arvense*	*Agrostis stolonifera*
Populus tremuloides	*Juniperus communis*	*Cirsium sp.*	*Carex lanuginosa*
Salix lutea		*Ranunculus cymbalaria*	*Juncus longistylis*
Salix sp.			*Bromus carinatus*
			Elymus trachycaulus
			Poa fendleriana

POOL ATTRIBUTES

% area in pools: 40

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 65

% bank length with overhanging vegetation: 50

BANK CONDITION

% bank length vegetated, stable: 75

% bank length unvegetated, stable: 25

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) There was a discrepancy with total transect length between 1999 (42 ft.) and Oct 2003 (45 ft.); July 2004 and October2004 were consistent at 45 ft.
2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. Green Line: Also measured on these transects.
3) Photograph taken from the left side.

4) The upper banks were wetland and probably influenced by the stream water.

DATA SUMMARIES

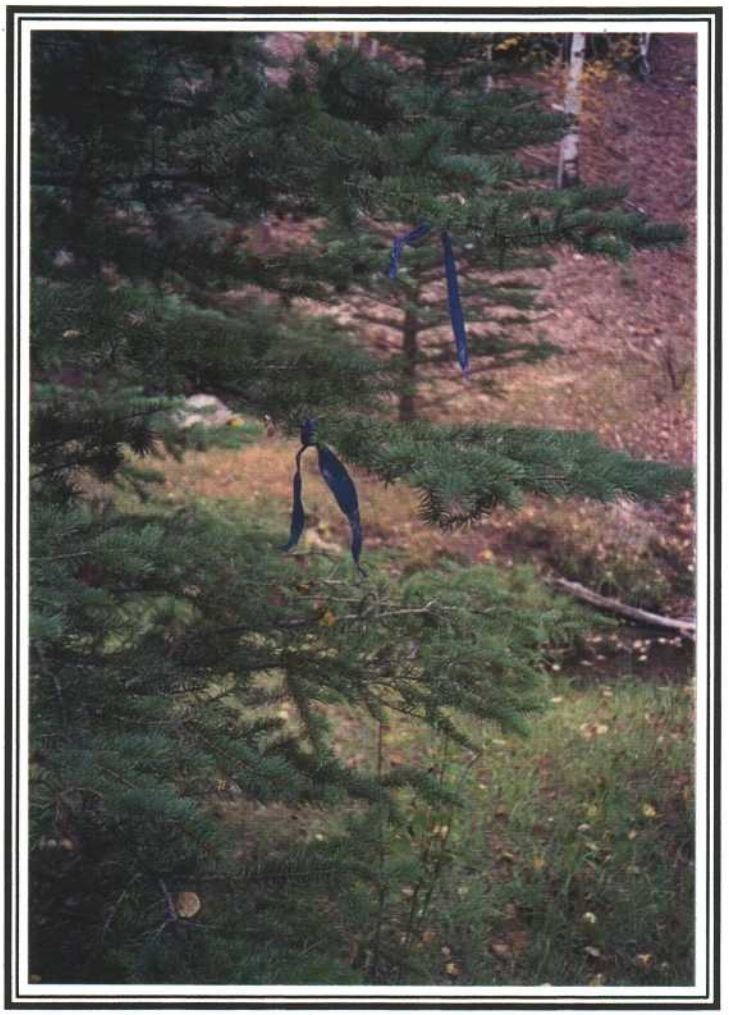
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-13		Left	17.0	*Agrostis stolonifera/Salix lutea/Carex lanuginosa*
		Right	12.0	*Agrostis stolonifera/Salix lutea/Carex lanuginosa*
		Channel	2.0	Water

Cover by Community Types - R-13
USDA Forest Service Protocol (1992)

-	-
UPLAND VEGETATION	
Bromus carinatus	14.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Salix lucida	22.00
Carex lanuginosa/Equisetum arvense	7.00
TOTAL COVER (Upland Species)	14.00
TOTAL COVER (Riparian Species)	29.00
BAREGROUND	0.00
ROCK	0.00
STREAM (water width)	2.00
-	-
TOTAL COVER	45.00

PHOTOGRAPHIC DOCUMENTATION



R-13

RIPARIAN COMPLEX DATA SHEET
October 2004

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-15

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: September 29-October 3, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss (Blackhawk Fm just upstream)

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,170 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
  - Falcon Family Soils: 55 %
  - Sandstone Outcrop: 30%
  - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Aspen Right: Spruce

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: active movement (not climax)

APPARENT FORAGE TREND: moderately stable

ESTIMATED FORAGE PRODUCTION: 100 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Juniperus communis*	*Aster sp.*	*Agrostis stolonifera*
Populus tremuloides	*Symphoricarpos oreophilus*	*Equisetum arvense*	
Cornus stolonifera	*Salix lutea*	*Epilobium angustifolium*	

POOL ATTRIBUTES

% area in pools: 40

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 50

% bank length gently sloping (>135°): 0

% bank length with overhanging vegetation: 5

BANK CONDITION

% bank length vegetated, stable: 30

% bank length unvegetated, stable: 20

% bank length vegetated, unstable: 10

% bank length unvegetated, unstable: 40

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable (left side); unstable (right side)

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Left side had horsetail in the "upland" area, but it was high enough in elevation that we felt it was influenced by side-slope water.
2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. Green Line: Also measured on these transects.
3) Length of transect line in Oct. 2003 was less than 1999 due to movement; in July 2004 it was

the same as Oct. 2003.

4) Photo from 1999 was from a different place (stake number indicated I was in the correct location in Oct 2003 and July 2004).

DATA SUMMARIES

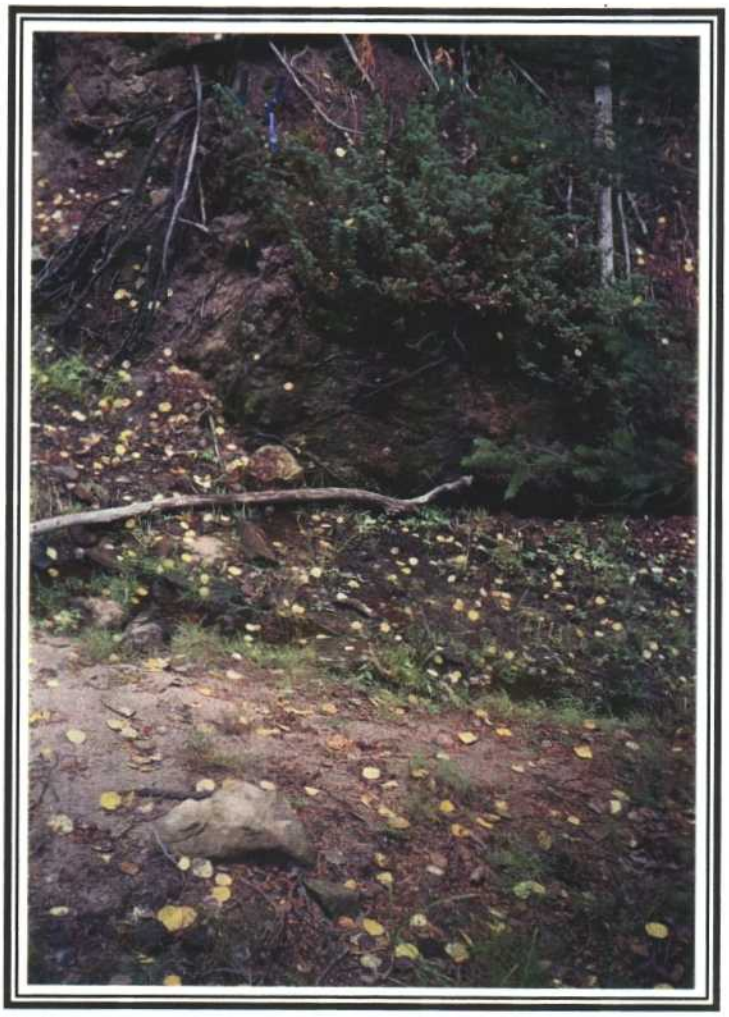
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-15		Left	4.5	*Equisetum arvense/Agrostis stolonifera/Carex lanuginosa*
		Right	0	
		Channel	3.0	Water 1.0; rock 2.0

Cover by Community Types - R-15

USDA Forest Service Protocol (1992)	
UPLAND VEGETATION	
Picea pungens	4.50
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Equisetum arvense	2.00
Carex lanuginosa/Equisetum arvensis	2.50
TOTAL COVER (Upland Species)	4.50
TOTAL COVER (Riparian Species)	4.50
BAREGROUND	13.00
ROCK	2.00
STREAM (water width)	1.00
MOSS	1.00
TOTAL COVER	26.00

PHOTOGRAPHIC DOCUMENTATION

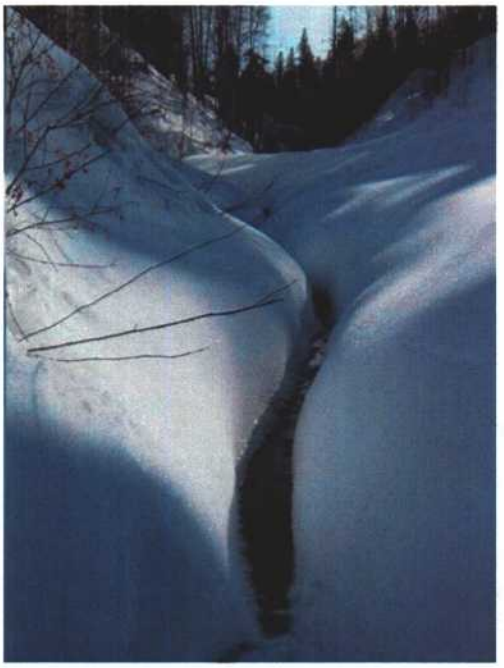


R-15

East Fork of Box Canyon Studies-Macroinvertibrate

Canyon Fuel Company, LLC – Sufco Mine has not received a copy of the 2004 Macroinvertibrate Survey Report to date. A copy of the Macroinvertibrate Study will be submitted when Consultant completes it.

Report of Hydrologic Monitoring of the East Fork of Box Canyon Creek, 2003-2004 Sufco Mine



28 March 2005

Canyon Fuel Company, LLC
Sufco Mine
Salina, Utah

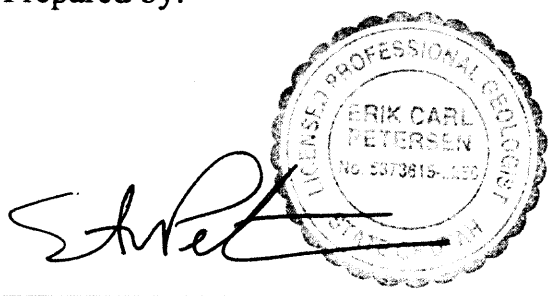
PETERSEN HYDROLOGIC
CONSULTANTS IN HYDROGEOLOGY

Report of Hydrologic Monitoring of the East Fork of Box Canyon Creek, 2003-2004 Sufco Mine

28 March 2005

Canyon Fuel Company, LLC
SUFCO Mine
Salina, Utah

Prepared by:



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Senior Hydrogeologist
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Report of Hydrologic Monitoring of the East Fork of Box Canyon Creek, 2003 -2004

1.0 Introduction

Canyon Fuel Company's Sufco Mine is located in the southern Wasatch Plateau coal district, approximately 20 miles east of Salina, Utah. During late 2003, longwall mining in the 3 Left Pines East longwall panel occurred beneath a portion of the East Fork of Box Canyon Creek, a perennial tributary to Box Canyon Creek (Figure 1). Beginning in mid-November 2003 and continuing through early January 2004, an approximately 2,000-foot reach of the East Fork stream drainage was subsided.

In conjunction with Sufco's approved mining plan for the undermining of the East Fork, Canyon Fuel committed to performing routine monitoring of discharge rates in potentially impacted stream reaches and adjacent springs. The results of these monitoring activities are summarized in this report.

Including this introduction, this report contains the following sections:

1. Introduction
2. Methods of Study
3. Presentation of Data
4. Overview of Hydrology of the East Fork
5. Discussion
6. References Cited

2.0 Methods of Study

- A site visit to the East Fork of Box Canyon was made on 22-23 September 2003 with representatives of the Utah Division of Oil, Gas, and Mining, the Manti La Sal National Forest, and Canyon Fuel. During this site visit, locations along the East Fork of Box Canyon Creek and at adjacent springs were selected for monitoring. The designated monitoring sites were labeled and marked in the field with flagging and wooden stakes. At a later time, three additional monitoring sites located further downstream in the East Fork drainage were selected for monitoring.

- The East Fork of Box Canyon was accessed and individual monitoring sites were monitored at intervals specified in the approved monitoring plan. During the summer and early fall months, the canyon was accessed by four-wheel drive vehicles. Where possible, during the late fall, winter, and spring months, the canyon was accessed using ATV's or snowmobiles. During certain times of the year, the canyon could not reasonably be accessed in a safe manner.

- Discharge rates in the East Fork of Box Canyon Creek and at springs were measured using a stopwatch and a calibrated container. The measurements were performed by diverting the stream or spring discharge through a plastic pipe and performing time-to-fill measurements using the calibrated container. Time-to-fill measurements were repeated at a site until the discharge through the pipe had stabilized. Generally, after the discharge from the pipe had stabilized, at least three additional time-to-fill measurements were performed. The time-to-fill values measured after the discharge had stabilized were averaged and used to calculate the discharge rate. Where noted, in some instances, such as where stream flow was partially obscured beneath the ice, discharge rates in the East Fork were estimated.

- The monitoring station was digitally photographed during the monitoring event.

- The discharge data were compiled into electronic format and analyzed using graphical methods.

3.0 Presentation of Data

The locations of spring and stream monitoring stations in the East Fork drainage are shown on Figure 1. Also shown on Figure 1 is the approximate area of subsidence associated with the mining of the 3 Left Pines East longwall panel in the East Fork drainage. Discharge measurements for the East Fork of Box Canyon Creek and nearby springs during 2003 and 2004 are presented in Table 1.

4.0 Overview of Hydrology of the East Fork of Box Canyon Drainage

The East Fork of Box Canyon is a small, perennial drainage that is tributary to Box Canyon Creek. Box Canyon Creek is tributary to Muddy Creek about 2 miles below the 3 Left Pines East subsidence area. Historically, discharge in the creek during the summer and fall months has ranged from less than 1 gpm to about to 22 gpm at the confluence with Box Canyon Creek (Utah Division of Oil, Gas and Mining, 2005, on-line hydrology database).

Historically, the uppermost extent of perennial discharge in the East Fork of Box Canyon Creek has occurred near monitoring sites EFB-6 (Sufco monitoring site Pines 106). Above station EFB-6, the drainage is commonly dry or has only a very meager discharge. Below EFB-6, the discharge in the creek gradually increases downstream as a result of groundwater inflows from the stream bank and from springs located along the adjacent hillsides. Based on observations of the stream channel made during quarterly monitoring visits since 1998, it is apparent that the stream does not gain appreciably below monitoring station EFB-11. Rather, it has been observed that surface-water discharge rates in the middle and lower reaches of the East Fork of Box Canyon are sometimes lower than those near EFB-11 located higher in the drainage. This is particularly true in the hot summer and early fall months. This is likely a result of evapotranspiration losses and groundwater-surface water interactions between the creek and adjacent alluvial groundwater systems in the middle and lower reaches of the canyon. (In an attempt to quantify groundwater-surface water interactions in the lower reaches of the East Fork, monitoring stations EFB-11B and EFB-11C were monitored periodically.)

5.0 Discussion

The East Fork of Box Canyon Creek was undermined using full-extraction longwall mining techniques starting on approximately 13 November 2003. Undermining of the drainage continued until approximately 5 January 2004. On 10 October 2003, prior to the undermining of the region, all of the East Fork monitoring stations were monitored and inspected to determine pre-mining conditions in the canyon.

As monitoring of the drainage continued after the undermining of the drainage had commenced, it was soon noted that discharge in the stream channel had increased significantly above levels typical for the drainage (Table 1). A similar occurrence was observed at spring Pines 214 (Table 1). This condition was anticipated (Petersen Hydrologic, 2003), and was likely a result of the compression (squeezing) of the aquifer matrix as the stress field associated with the progression of the longwall mining face moved through the area. The effects of this phenomenon are apparent in the hydrograph of stream discharge at monitoring station EFB-11 in Figure 2. It is apparent in Figure 2 that the discharge in the East Fork increased rapidly during November 2003 as mining in the area commenced, then declined rapidly during December 2003 and January 2004 as the longwall face passed beyond the region.

It was predicted before the stream was undermined that tension fractures that could form in the stream substrate would have small (less than ½-inch) apertures (Petersen Hydrologic, 2003). Based on visual inspection of the East Fork drainage during 2003 and 2004, it was

apparent that this was the case. It was also predicted that these potential tension cracks would be "dead-end" openings that would not be capable of conveying surface water laterally out of the East Fork drainage or downward into the Sufco Mine (Petersen Hydrologic, 2003). Based on the results of discharge measurements performed in the East Fork during 2003 and 2004, it is apparent that no significant quantities of surface water were lost from the drainage as a result of mining activities. This conclusion is based on the data presented in Figure 3. In Figure 3, the maximum discharge measured in the creek (station EFB-11) is plotted against the maximum downstream discharge rate below the subsided area (stations EFB-11A, B, or C). It is apparent in Figure 3 that the quantity of water flowing out of the subsided area is similar to the maximum quantity measured upstream in the creek. During the spring and summer months of 2004, the discharge at the lower monitoring site was slightly less than that measured above, while in November of 2004 the discharge at the lower site was slightly greater than that measured above. Based on this information, and the fact that the overall discharge in the creek during 2004 was generally similar to that observed during previous (pre-mining) years, there is no evidence to suggest that any appreciable quantity of surface water has been removed from the East Fork drainage as a result of mining-related activities at the Sufco Mine.

It was observed during December 2003 that discharge from the springs located along the base of the Castlegate Sandstone cliff on the northeast hillside above the creek ceased. Decreases in discharge from spring Pines 214 were also measured during this time. During baseflow conditions in October 2003, the combined flow from springs EFB-12, EFB-13, and EFB-14 was approximately 3.0 gpm. Although it was considered unlikely, it had been predicted that

there was a possibility that discharge from these springs could be diverted small distances downgradient as a result of mining-induced cracking of bedrock near the spring (Petersen Hydrologic, 2003). It is apparent that this phenomenon occurred at these springs. Although there is currently no discharge from these springs at the surface (EFB-12, EFB-13, and EFB-14), it appears that the groundwater system that previously supported discharge from these springs now discharges groundwater to the creek through diffuse seepage along the stream bank a short distance lower in the drainage. This conclusion is based on two considerations. Firstly, a zone of saturated soil and colluvium was noted along the stream bank slightly downgradient of the spring locations at approximately the same time as the springs were going dry. On 8 December 2003, it was observed that the saturated sediments had slid, forming a small slump near the East Fork channel bottom. Visible groundwater discharge continued to be observed from the slump area throughout the remainder of 2003 and 2004. It seems likely that this discharge, and diffuse discharge occurring at other locations along the stream channel represent the approximately 3 gpm of groundwater that was previously discharging from the springs higher on the hillside.

The second line of evidence suggesting that discharge from the groundwater system that previously supported springs EFB-12, EFB-13, and EFB-14 continues to flow into the East Fork drainage is shown in Figure 4. In Figure 4, discharge measurements from monitoring stations during four selected monitoring events are plotted together with their relative linear distance down the stream channel from EFB-1. Measurements are plotted for the pre-mining baseflow condition (10 October 03), the peak of mining-enhanced discharge in the creek (15 December 03), the early summer of 2004 after a minimal runoff season (25 June 2004), and

the late-season baseflow conditions after repairs to the stream channel (discussed later) had been performed (2 November 2004). It is apparent in each of these plots that discharge rates in the East Fork consistently increased downstream from EFB-6 to EFB-11 (which generally corresponds to the area of spring discharge from near the base of the Castlegate Sandstone). It is noteworthy that the rate of increase in the creek (i.e., the slope of the curve in Figure 4), is similar both pre- and post-undermining. If the groundwater system that provided baseflow to the creek and supported springs EFB-12, EFB-13, and EFB-14 was drained (i.e., the groundwater was diverted downward into the mine or laterally into another drainage) measurable groundwater discharge to the creek would not be anticipated. That the stream continues to gain water through this reach at a magnitude similar to that measured before mining supports the conclusion that only the discharge locations of the impacted springs have been moved, and dewatering of the groundwater system has not occurred.

It is noteworthy that discharge from the spring at station EFB-8, which is likely sourced from the same groundwater system that supports EFB-12, EFB-13, and EFB-14, does not appear to have been impacted as a result of mining in the 3 Left Pines East panel. The discharge location for the spring at EFB-8 is situated above a gateroad for the 3 Left Pines East panel and within the angle-of-draw for subsidence. That the spring has not been impacted could indicate that the strata near that spring have experienced less bedrock fracturing. It may also be due to the fact that the discharge location for the spring adjacent to station EFB-8 is in the canyon bottom and is only a few feet higher than the elevation of the creek near the spring.

When the East Fork drainage was first visited in the spring of 2004 (29 April 2004), it was noted that several short reaches of the creek were dry. The lengths of the dry reaches varied from a few feet to a few hundred feet. Because the stream drainage was mostly covered with snow during the December 2003 and January 2004 monitoring events, it was not known whether the dry reaches of the creek existed prior to April 2004 or whether they had occurred more recently. As discussed above, it has been demonstrated that surface water was not being diverted into deeper geologic formations or into the Sufco Mine openings, nor was it being redirected to adjacent surface water drainages. It is noteworthy that the dry stream reaches were primarily observed in the Blackhawk Formation where thin- to medium-bedded silty sandstone rocks were exposed in the bottom of the stream channel. Where these bedded sedimentary rocks are exposed at the surface in areas that experienced subsidence fracturing and high geologic stresses, the sandstones tended to buckle or break along horizontal bedding planes. This resulted in loose slabs of rock lying on top of more competent rock in the stream channel. The buckling of the thin-bedded strata likely occurs primarily very near the surface where there is no vertical confining pressure on the rocks. In deeper horizons where there is vertical confining pressure, the buckling of the rocks is likely much less intense, and fracture apertures (through which water can travel through the subsurface) are likely very small. During periods of low flow in the East Fork, surface water was observed flowing beneath the loose, broken rock strata in the shallow subsurface, leaving the overlying channel surface dry. Surface water was also observed flowing through tension fractures that were largely oriented parallel or sub-parallel to the direction of the stream flow. It is likely that movement of surface water through both the loose, buckled bedded sedimentary strata and through the tension cracks is limited to the shallow sub-surface. This conclusion is supported by the fact

that the dry stream reaches were typically relatively short in length, with generally only a few feet to a few tens of feet of topographic elevation difference between the upper and lower extents of the dry reaches. Typically, surface water re-emerged in the stream drainage where the first or second low-permeability shaley horizon intersected the channel bottom. If the surface water beneath the dry stream reaches were migrating through deep strata, it would be anticipated that the lengths of the dry reaches would be longer (i.e., the surface water would re-emerge farther downstream at lower topographic elevations or not at all).

The conclusion that the water flowing beneath the dry stream reaches was moving through the shallow subsurface is also evidenced by observations at ledges and waterfalls in the East Fork drainage. At many such locations, water was observed discharging from the waterfall or ledge only a few inches to a few feet below the top of the ledge (Figure 5).

Beginning on 21 September 2004 and continuing to 5 October 2004, repairs were made to the stream channel in the East Fork to restore continuous surface water flow to the dry stream reaches. In some locations, this was accomplished simply by removing the loose, buckled, bedded sandstone plates from the channel substrate, revealing the surface flow beneath. In other locations, this was accomplished by placing bentonite in the stream channel in tension cracks or gravelly zones. These repairs were successful in restoring surface water flow in essentially all of the stream reaches in East Fork channel subsided by the mining of the 3 Left Pines East panel. When the East Fork drainage was monitored on 2-3 November 2004, it appeared that stream flow in the drainage was still essentially continuous, although portions of the drainage were obscured by snow and ice cover.

References Cited

Utah Division of Oil, Gas and Mining, 2005, On-line hydrology database, Sufco Mine, http://ogm.utah.gov/coal/edi/wqdb.htm.

Petersen Hydrologic, 2003, Probable hydrologic consequences of longwall mining of the 3 Left panel modification area at the Sufco Mine, Unpublished consulting report for Canyon Fuel Company, LLC.

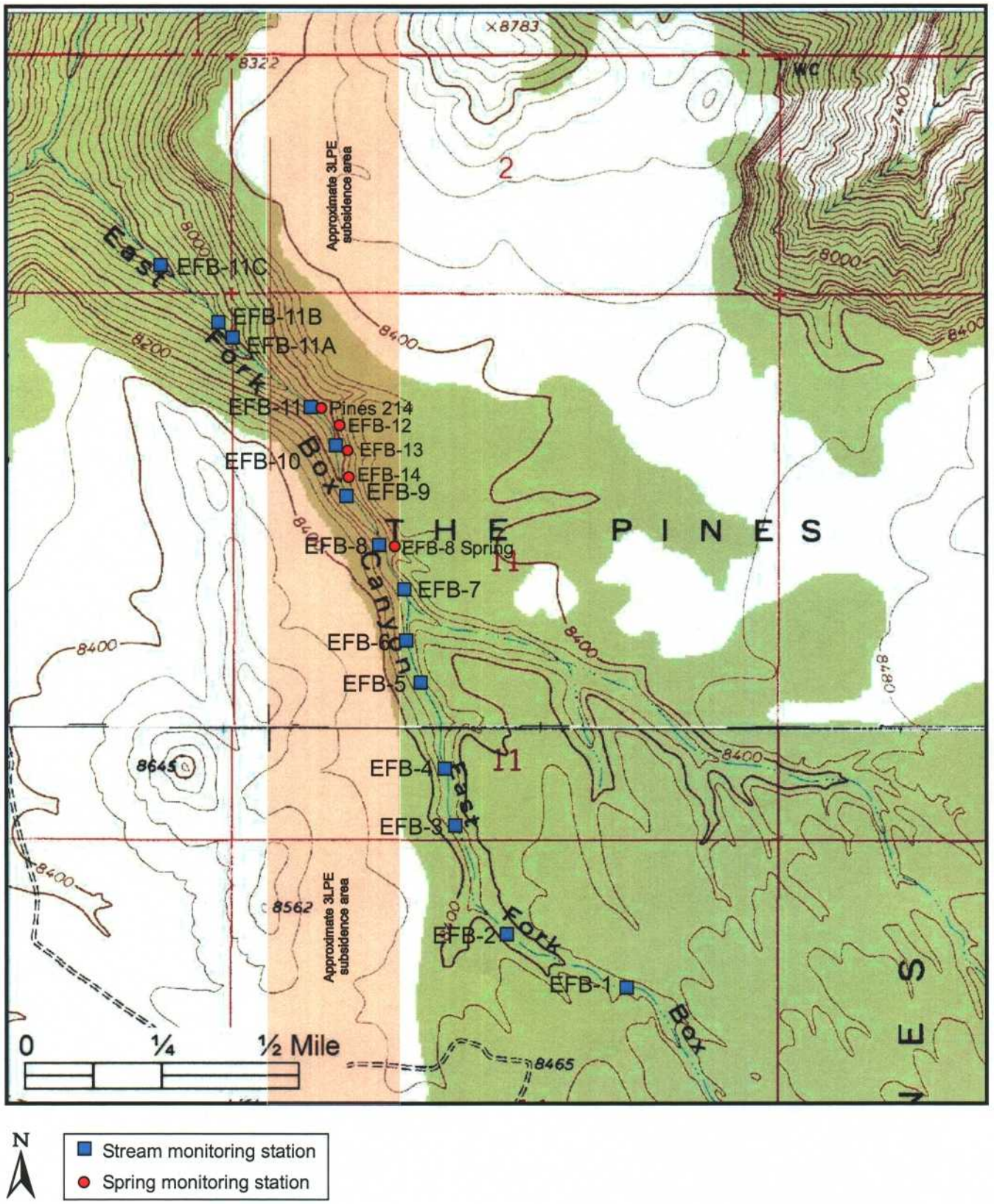


Figure 1 Monitoring locations in th East Fork of Box Canyon.

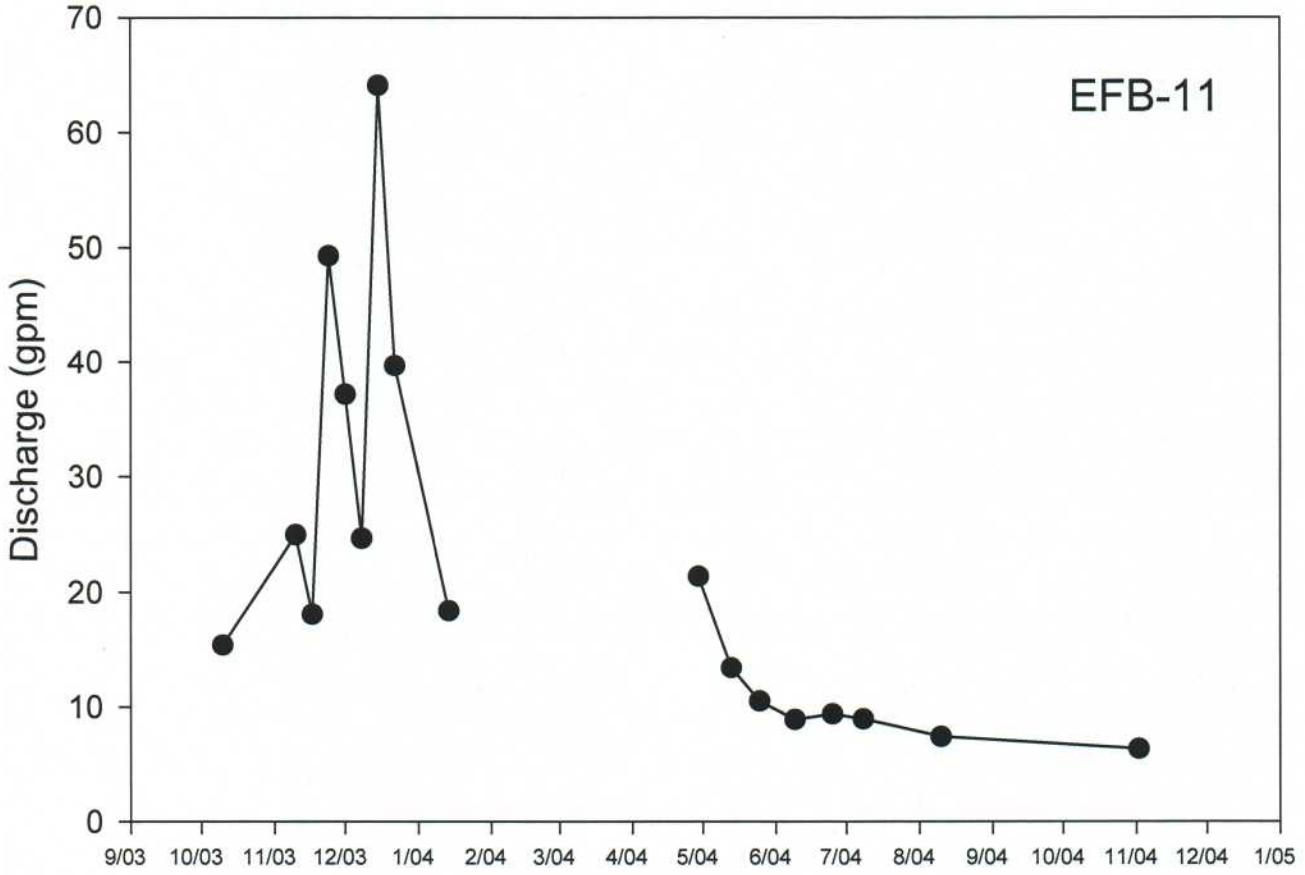


Figure 2 Discharge in the East Fork of Box Canyon Creek at monitoring station EFB-11.

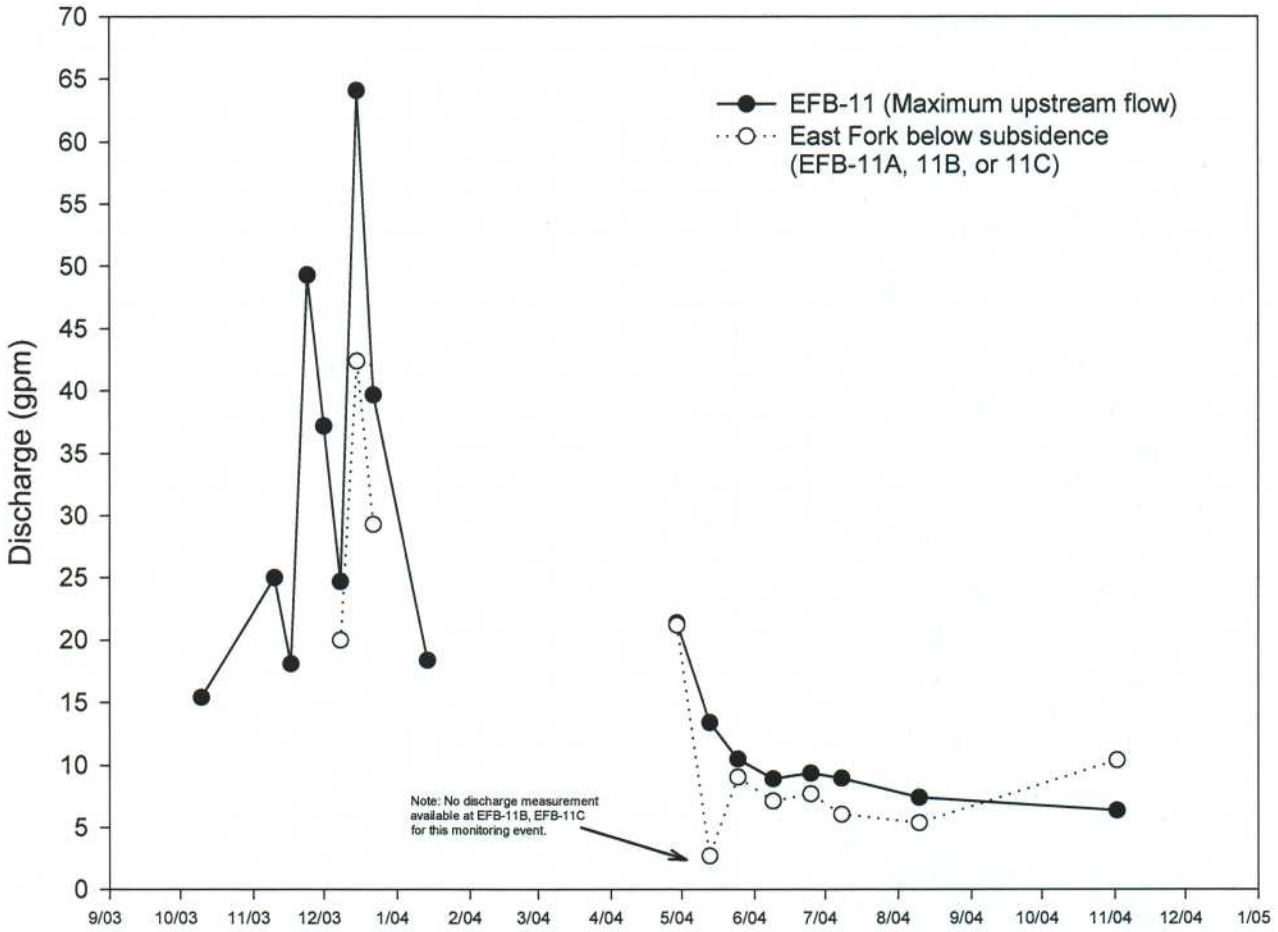
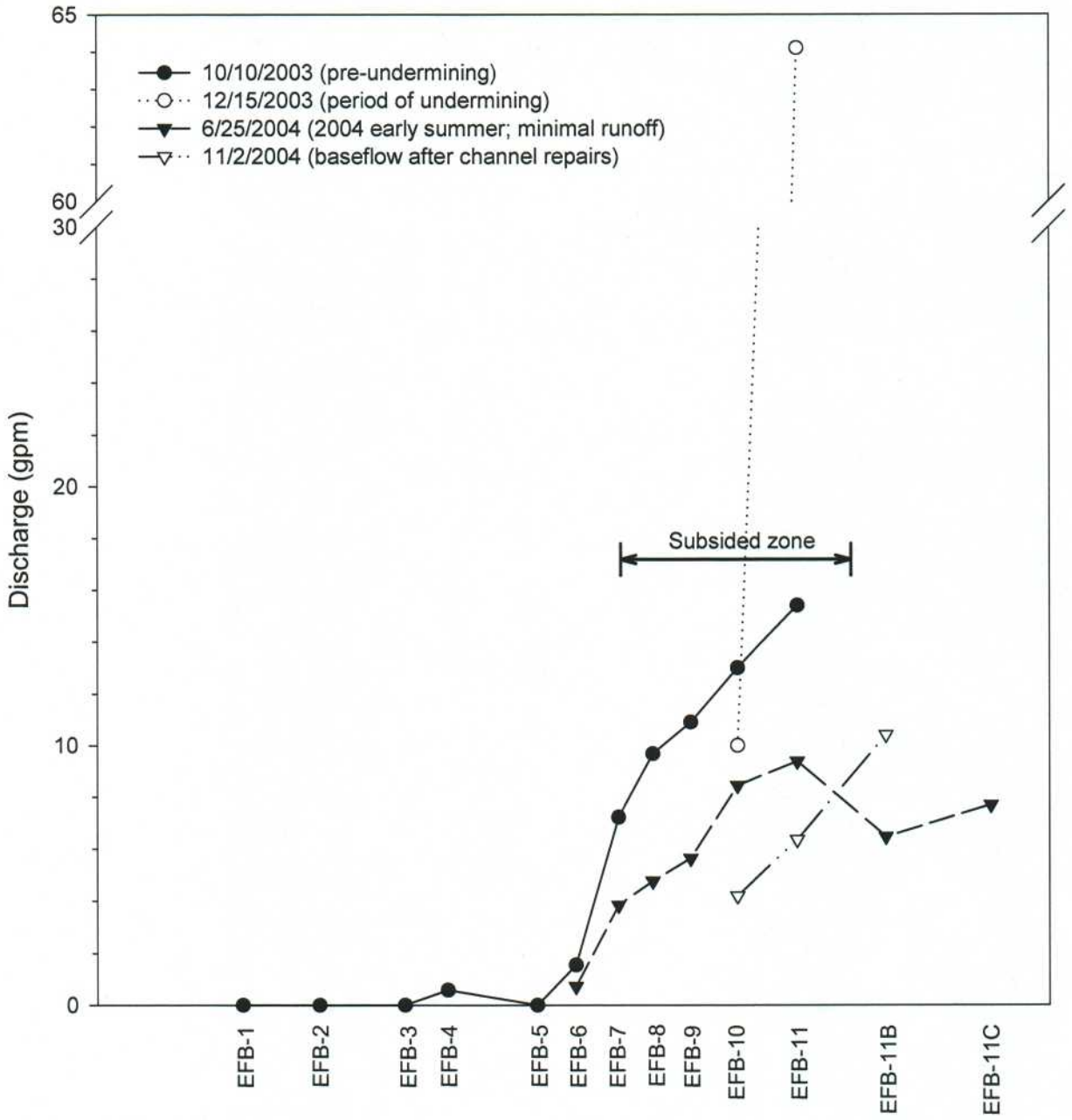


Figure 3 Comparison of maximum discharge in the East Fork of Box Canyon Creek with maximum discharge in the creek below the subsided area.



Note: Discharge data from EFB-11A not shown on graph.

Figure 4 Plots of discharge from East Fork of Box Canyon Creek monitoring sites.

Figure 5 Waterfall in the East Fork of Box Canyon near EFB-11.

Table 1 East Fork Box Canyon flow measurements 2003 - 2004

PETERSEN HYDROLOGIC

Station	10/10/03	11/10/03	11/17/03	11/24/03	12/1/03	12/8/03	12/15/03	12/22/03	12/29/03	1/5/04	1/14/04	4/23/04	4/29/04	5/13/04	5/25/04	6/9/04	6/25/04	7/8/04	8/10/04	11/2/04
EFB-1	0								Inaccessible	Inaccessible		Inaccessible				0		0		0
EFB-2	0								Inaccessible	Inaccessible		Inaccessible				0		0		0
EFB-3	0								Inaccessible	Inaccessible		Inaccessible				0		0		0
EFB-4	0.588								Inaccessible	Inaccessible		Inaccessible				0.441		0.20		0.46
EFB-5	0								Inaccessible	Inaccessible		Inaccessible				0		0		0
EFB-6 (Pines 106)	1.55								Inaccessible	Inaccessible		Inaccessible	3.1	1.03	1.21	1.10	0.72	0.27	0.14	0.44
EFB-7	7.23								Inaccessible	Inaccessible	frozen	Inaccessible	15.9	7.66	6.06	4.62	3.83	3.16	2.46	5.04
EFB-8 (creek)	9.68							frozen	Inaccessible	Inaccessible	frozen	Inaccessible	15.4	8.42	7.02	5.20	4.76	4.34	3.36	8.25
(spring)	0.545							frozen	Inaccessible	Inaccessible	frozen	Inaccessible	0.65	0.58	0.503	0.457	0.495	0.44	0.36	0.38
EFB-9	10.9						frozen	frozen	Inaccessible	Inaccessible	frozen	Inaccessible	16.7	7.74	6.98	5.50	5.64	4.41	2.91	8.53
EFB-10	13.0	18.8	14.5	8.6	11.0	frozen	10 est.	30 est.	Inaccessible	Inaccessible	Inaccessible	Inaccessible	18.4	6.8	9.09	7.76	8.44	7.35	5.45	4.19
Pines 214	2.58	3.8	2.26	37.0	9.1	5.49	3.97	1.15	Inaccessible	Inaccessible	frozen	Inaccessible	1.32	0.39	0.18	0.081	0.224	0.12	0.09	0.17
EFB-11	15.4	25.0	18.1	49.3	37.2	24.7	64.1	39.7	Inaccessible	Inaccessible	18.4	Inaccessible	21.4	13.4	10.5	8.91	9.38	8.96	7.41	6.36
EFB-11A						20.0	42.4	29.3	Inaccessible	Inaccessible			10.1	2.69	2.20	1.29	1.15	0.98	1.13	Inaccessible
EFB-11B									Inaccessible	Inaccessible			21.2		9.05	7.11	6.47	6.05	5.36	10.40
EFB-11C									Inaccessible	Inaccessible							7.69	6.02	5.1	Inaccessible
EFB-12 (north)	0.407			0.371	0.254	frozen	0	0	Inaccessible	Inaccessible		Inaccessible	0	0	0	0	0	0	0	0
EFB-12 (south)	0.176			0.156	0.144	frozen	0	0	Inaccessible	Inaccessible		Inaccessible	0	0	0	0	0	0	0	0
EFB-13 (north)	0.704			0.785	0.719	0.39	0	0	Inaccessible	Inaccessible		Inaccessible	0	0	0	0	0	0	0	0
EFB-13 (south)	1.57			1.85	1.82	1.64	0.093	0.0061	Inaccessible	Inaccessible		Inaccessible	0	0	0	0	0	0	0	0
EFB-14	0.140			.15 est.	0.142	0.108	0.071	0	Inaccessible	Inaccessible		Inaccessible	0	0	0	0	0	0	0	0

PETERSEN HYDROLOGIC

16 July 2004

Mr. Mike Davis
Canyon Fuel Company, LLC
Sufco Mine
397 South 800 West
Salina, Utah 84526

Mike,

At your request we have performed an investigation of surface-water quality in the East Fork of Box Canyon in the Sufco Mine permit area. Specifically, the purpose of this investigation is to evaluate the water quality in the stream in the vicinity of cracked stream substrate associated with the recent mining-related subsidence of the stream channel.

Overview

The East Fork of Box Canyon Creek is a small stream with a baseflow discharge typically ranging from about 8 to 21 gpm at the confluence with Box Canyon Creek. Longwall mining in the 3LPE panel occurred beneath the East Fork of Box Canyon during November and December 2003. As a result of longwall-mining-related subsidence, the stream substrate in the East Fork was cracked in some locations and some horizontal fracturing along bedding planes in thin-bedded rock strata occurred. Consequently, surface waters are routed through these fractures in the shallow subsurface in some locations. The presence of low-permeability strata beneath the stream channel prevents the downward migration of surface water into deeper horizons or into the mine. Rather, stream waters migrating through the fractures reenter the stream channel at downstream locations where the low-permeability (perching) horizons intersect the channel.

When the East Fork of Box Canyon was visited during April of 2004 (after being inaccessible the previous winter), it was observed that a short reach of the stream channel had been stained reddish-orange. The orange staining occurred at a location between stream monitoring sites EFB-11 and EFB-11A and appeared to originate from a relatively discrete location. The intensity of the staining gradually diminished downstream until becoming absent a few hundred feet downstream.

Data Collection

On 25 June 2004, surface water samples were collected at three locations in the East Fork of Box Canyon. These included a sample upstream of the orange-stained area, a sample

2695 N. 600 E. LEHI, UTAH 84043 (801) 766-4006

from the most intensely orange-stained area, and a sample near the lowermost extent of the orange-staining. Water samples were analyzed for temperature, pH, specific conductance, and dissolved oxygen in the field. Samples for dissolved metals were filtered in the field through a 0.45µm filter and preserved with nitric acid. The water samples were delivered to SGS Minerals, Huntington Laboratory for analysis. The field water-quality parameters measured at each site and the laboratory analytical results are presented in Table 1. The SGS Laboratory reporting sheets are attached.

Data Analysis

Surface water sampled in the East Fork above the orange-stained area is of the calcium-magnesium-bicarbonate-sulfate chemical type with a TDS of 325 mg/l (Table 1). Concentrations of total and dissolved iron and manganese are at or below the laboratory detection limit. Water within the orange-stained area is of similar chemical type with a TDS concentration of 374 mg/l and somewhat increased concentrations of calcium, magnesium, bicarbonate and sulfate. These increases are most likely attributable primarily to the creek water coming into contact with pyrite or other sulfide minerals on freshly broken fracture surfaces in the rocks of the Blackhawk Formation. Pyrite is known regionally to exist in the coals and other rocks of the Blackhawk Formation.

Creek water downstream of the orange-stained area is of the same geochemical type and has a TDS concentration similar to that occurring in the orange-stained area. The pH and dissolved oxygen concentrations are similar to those measured above the orange stained area. Total and dissolved iron and manganese concentrations are below laboratory detection limits. Oil and Grease was not detected in any of the three surface water samples.

The geochemical evolutionary pathway most likely responsible for the observed water-quality characteristics in the East Fork of Box Canyon is described briefly below.

Pyrite is oxidized when it comes into contact with oxygenated water. This reaction is represented in a simplified form as:

$$FeS_{2\,(S)} + 7/2\ O_2 + H_2O = Fe^{2+} + 2SO_4^{2-} + 2H^+ \quad \text{(pyrite oxidation)}$$

This reaction, which is commonly facilitated and enhanced by the presence of bacteria, yields free, reduced iron (Fe^{2+}), sulfate, and H^+ (acid), and removes oxygen from the water. The liberation of H^+ in this reaction results in a temporary lowering of the pH and facilitates the dissolution of carbonate minerals according to:

$$H^+ + CaCO_3 = Ca^{2+} + HCO_3^- \quad \text{(calcite dissolution)}$$
$$2H^+ + CaMg(CO_3)_2 = Ca^{2+} + Mg^{2+} + 2HCO_3 \quad \text{(dolomite dissolution)}$$

These two reactions result in an increase in the calcium, magnesium, and bicarbonate concentrations of the water and consume H^+, resulting in a rising of the pH. Because of

the abundance of carbonate minerals in the coal fields of the western United States, the acid produced from pyrite oxidation is readily consumed in the reactions described above and acid-mine-drainage does not occur.

In some instances, ion-exchange may occur on clay minerals. These reactions can be represented in a simplified form as:

Ca^{2+} + Na-clay = $2Na^{+}$ + Ca-clay (ion exchange on clay minerals)
Mg^{2+} + Na-clay = $2Na^{+}$ + Mg-clay (ion exchange on clay minerals)

These reactions result in an increase in the concentration of sodium with corresponding decreases in calcium and/or magnesium concentrations.

Water flowing in a surface stream that is fully aerated with near neutral pH generally will generally not contain more than a few micrograms per liter of dissolved iron (Hem, 1985). This is because oxygen is continuously present in an actively flowing stream and the Fe^{2+} is rapidly oxidized to Fe^{3+} according to:

$$Fe^{2+} + 1/4\ O_2 + H^{+} = Fe^{3+} + 1/2\ H_2O \quad \text{(iron oxidation)}$$

The oxidized iron is subsequently precipitated as a solid (commonly as an amorphous iron hydroxide) and settles to the creek bottom. This simplified reaction may be expressed as:

$$Fe^{3+} + 3H_2O = Fe(OH)_{3\ (s)} + 3H^{-} \quad \text{(iron hydroxide precipitation)}$$

The H^{-} produced in this reaction is consumed in the carbonate mineral dissolution reactions described above. It should be noted that iron-hydroxide precipitation has been noted to lesser extents in the East Fork of Box Canyon in non-undermined stream reaches upstream of the 3LPE panel (most notably in the creek headwaters region above and near monitoring site EFB-6).

The occurrence of manganese in the creek water is likely controlled by oxidation, reduction, and precipitation reactions that are generally similar to those for iron.

Conclusions

The observed orange staining of the short reach of the stream channel and the modest increases in TDS observed in the East Fork are most likely the result of the exposure of creek water to pyrite or other sulfide minerals on freshly broken fracture surfaces and subsequent pyrite oxidation.

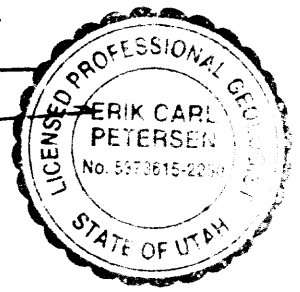
The fact that no dissolved iron was present in any of the three stream samples clearly indicates that any iron liberated through pyrite oxidation has been rapidly oxidized and removed from the water. The presence of total iron (1.39 mg/l) in the water sample from

the most orange-stained area is likely attributable to the inclusion in the water sample of fine grained iron-hydroxide sediments disturbed at the time of sampling. Similarly, there is no manganese (total or dissolved) in the stream water below the orange-stained area, suggesting that the trace amount of manganese present in the orange-stained area (0.161 mg/l) has likely been removed by precipitation. Dissolved oxygen and pH levels in the East Fork below the orange-stained area are similar to upstream levels.

Other than a minor increase in TDS concentration (66 mg/l), there does not appear to have been any significant degradation in the water quality to the East Fork. In the future, pyrite oxidation in the East Fork will likely continue only until the exposed pyrite has been consumed. At such a time, TDS concentrations in the creek will likely decrease and the deposition of iron hydroxide in the stream channel will likely cease. It seems probable that during future torrential thunderstorm events, much of the amorphous iron hydroxide that has accumulated will be scoured from the stream channel.

Please feel free to contact me should you have any questions in this regard.

Sincerely,



Erik C. Petersen, P.G.
Principal Hydrogeologist
Utah PG #5373615-2250

Table 1 East Fork of Box Canyon water quality information, 25 June 2004.

	T (°C)	pH	D. Ox. (mg/l)	O&G (mg/l)	Cond (µS)	TDS (mg/l)	Ca^{2+} (mg/l)	Mg^{2+} (mg/l)	Na^{+} (mg/l)	K^{+} (mg/l)	HCO_3^{-} (mg/l)	CO_3^{2-} (mg/l)	SO_4^{2-} (mg/l)	Cl^{-} (mg/l)	Fe(t) (mg/l)	Fe(d) (mg/l)	Mn(t) (meq/l)	Mn(d) (meq/l)	Cat. (meq/l)	An. (meq/l)	Bal. (%)
East Fork of Box Canyon																					
Above iron-stained area	7.4	8.18	7.79	<2	478	325	67.6	24.3	9.07	1.96	265.8	<5	77	10	<0.05	<0.03	0.002	0.002	5.8	6.2	-3.5
Within iron-stained area	8.4	7.93	6.36	<2	585	374	79.0	32.4	9.33	1.82	325.5	<5	98	11	1.39	<0.03	0.161	0.161	7.1	7.7	-4.3
Below iron-stained area	7.4	8.09	7.73	<2	593	391	77.1	35.2	10.20	1.92	329.2	<5	103	11	<0.05	<0.03	<0.002	<0.002	7.2	7.9	-4.1

SGS

July 8, 2004

CANYON FUEL COMPANY, SUFCO MINE
397 South 800 West
Salina UT 84654

Sample identification by
Sufco

ID:EAST FORK FE-ABOVE

Kind of sample reported to us Water

RECEIVED 1400
SAMPLED 1845
FIELD MEASUREMENTS
FLOW 9.4 TEMP 7.4
COND 478 pH 8.18
D.O. 7.79

Sample taken at Sufco

Sample taken by E.P./K.Z.

Date sampled June 25, 2004

Date received June 28, 2004

FIELD FILTERED

Analysis report no. 59-26540

Parameter	Result	MRL	Units	Method	Analyzed Date/Time/Analyst	
Alkalinity, Bicarbonate	218	5	mg/l as $CaCO_3$	SM 2320 B	06-29-2004 1308	BLP
Alkalinity, Carbonate	<5	5	mg/l as $CaCO_3$	SM 2320 B	06-29-2004 1308	BLP
Alkalinity, Total	218	5	mg/l as $CaCO_3$	SM 2320 B	06-29-2004 1308	BLP
Anions	6.2	----	meq/l	---------	07-08-2004 1425	SB
Calcium, Dissolved	67.60	0.03	mg/l	EPA 200.7	07-02-2004 1351	JJ
Cations	5.8	----	meq/l	---------	07-08-2004 1425	SB
Chloride	10	1	mg/l	EPA 300.0	06-29-2004 1325	BLP
Hardness, Total	269	----	mg/l as $CaCO_3$	SM2340-B	07-08-2004 1425	SB
Iron, Total	<0.05	0.050	mg/l	EPA 200.7	07-06-2004 1352	BLP
Iron, Dissolved	<0.03	0.030	mg/l	EPA 200.7	07-02-2004 1351	JJ
Magnesium, Dissolved	24.30	0.01	mg/l	EPA 200.7	07-02-2004 1351	JJ
Manganese, Total	0.002	0.002	mg/l	EPA 200.7	07-06-2004 1352	BLP
Manganese, Dissolved	0.002	0.002	mg/l	EPA 200.7	07-02-2004 1351	JJ
Oil & Grease	<2	2	mg/l	EPA 413.1	07-07-2004 0800	JJ
Potassium, Dissolved	1.96	0.14	mg/l	EPA 200.7	07-02-2004 1351	JJ
Sodium, Dissolved	9.07	0.09	mg/l	EPA 200.7	07-02-2004 1351	JJ
Solids, Total Dissolved	325	30	mg/l	EPA 160.1	06-29-2004 0800	JJ
Sulfate	77	1	mg/l	EPA 300.0	06-29-2004 1325	BLP
Cation/Anion Balance	-3.5	----	%		07-08-2004 1425	SB

EMBER ACIL

Respectfully submitted,
SGS NORTH AMERICA INC.

Huntington Laboratory

Minerals Services Division
P.O. Box 1020, Huntington, UT 84528 t (435) 653-2311 f (435) 653-2436 www.sgs.com

SGS

July 8, 2004

CANYON FUEL COMPANY, SUFCO MINE
397 South 800 West
Salina UT 84654

Sample identification by
Sufco

ID:EAST FORK FE-MIDDLE

Kind of sample reported to us Water

Sample taken at Sufco

Sample taken by E.P./K.Z.

Date sampled June 25, 2004

Date received June 28, 2004

RECEIVED 1400
SAMPLED 1830
FIELD MEASUREMENTS
FLOW 2 TEMP 8.4
COND 585 pH 7.93
D.O. 6.36
FIELD FILTERED

Analysis report no. 59-26539

Parameter	Result	MRL	Units	Method	Analyzed Date/Time/Analyst
Alkalinity, Bicarbonate	267	5	mg/l as $CaCO_3$	SM 2320 B	06-29-2004 1308 BLP
Alkalinity, Carbonate	<5	5	mg/l as $CaCO_3$	SM 2320 B	06-29-2004 1308 BLP
Alkalinity, Total	267	5	mg/l as $CaCO_3$	SM 2320 B	06-29-2004 1308 BLP
Anions	7.7	----	meq/l	---------	07-08-2004 1425 SB
Calcium, Dissolved	79.00	0.03	mg/l	EPA 200.7	07-02-2004 1351 JJ
Cations	7.1	----	meq/l	---------	07-08-2004 1425 SB
Chloride	11	1	mg/l	EPA 300.0	06-29-2004 1325 BLP
Hardness, Total	331	----	mg/l as $CaCO_3$	SM2340-B	07-08-2004 1425 SB
Iron, Total	1.39	0.050	mg/l	EPA 200.7	07-06-2004 1352 BLP
Iron, Dissolved	<0.03	0.030	mg/l	EPA 200.7	07-02-2004 1351 JJ
Magnesium, Dissolved	32.40	0.01	mg/l	EPA 200.7	07-02-2004 1351 JJ
Manganese, Total	0.161	0.002	mg/l	EPA 200.7	07-06-2004 1352 BLP
Manganese, Dissolved	0.161	0.002	mg/l	EPA 200.7	07-02-2004 1351 JJ
Oil & Grease	<2	2	mg/l	EPA 413.1	07-07-2004 0800 JJ
Potassium, Dissolved	1.82	0.14	mg/l	EPA 200.7	07-02-2004 1351 JJ
Sodium, Dissolved	9.33	0.09	mg/l	EPA 200.7	07-02-2004 1351 JJ
Solids, Total Dissolved	374	30	mg/l	EPA 160.1	06-29-2004 0800 JJ
Sulfate	98	1	mg/l	EPA 300.0	06-29-2004 1325 BLP
Cation/Anion Balance	-4.3	----	%		07-08-2004 1425 SB

EMBER ACIL

Respectfully submitted,
SGS NORTH AMERICA INC.

Huntington Laboratory

Minerals Services Division
P.O. Box 1020, Huntington, UT 84528 t (435) 653-2311 f (435) 653-2436 www.sgs.com

SGS

July 8, 2004

CANYON FUEL COMPANY,SUFCO MINE
397 South 800 West
Salina UT 84654

Sample identification by
Sufco

ID:EAST FORK FE-BELOW

Kind of sample reported to us Water

Sample taken at Sufco

Sample taken by E.P./K.Z.

Date sampled June 25, 2004

Date received June 28, 2004

RECEIVED 1400
SAMPLED 1800
FIELD MEASUREMENTS
FLOW 1 TEMP 7.4
COND 593 pH 8.09
D.O. 7.73
FIELD FILTERED

Analysis report no. 59-26538

Parameter	Result	MRL	Units	Method	Analyzed Date/Time/Analyst
Alkalinity, Bicarbonate	270	5	mg/l as $CaCO_3$	SM 2320 B	06-29-2004 1308 BLP
Alkalinity, Carbonate	<5	5	mg/l as $CaCO_3$	SM 2320 B	06-29-2004 1308 BLP
Alkalinity, Total	270	5	mg/l as $CaCO_3$	SM 2320 B	06-29-2004 1308 BLP
Anions	7.9	----	meq/l	----------	07-08-2004 1425 SB
Calcium, Dissolved	77.10	0.03	mg/l	EPA 200.7	07-02-2004 1351 JJ
Cations	7.2	----	meq/l	----------	07-08-2004 1425 SB
Chloride	11	1	mg/l	EPA 300.0	06-29-2004 1325 BLP
Hardness, Total	337	----	mg/l as $CaCO_3$	SM2340-B	07-08-2004 1425 SB
Iron, Total	<0.05	0.050	mg/l	EPA 200.7	07-06-2004 1352 BLP
Iron, Dissolved	<0.03	0.030	mg/l	EPA 200.7	07-02-2004 1351 JJ
Magnesium, Dissolved	35.20	0.01	mg/l	EPA 200.7	07-02-2004 1351 JJ
Manganese, Total	<0.002	0.002	mg/l	EPA 200.7	07-06-2004 1352 BLP
Manganese, Dissolved	<0.002	0.002	mg/l	EPA 200.7	07-02-2004 1351
Oil & Grease	<2	2	mg/l	EPA 413.1	07-07-2004 0800 JJ
Potassium, Dissolved	1.92	0.14	mg/l	EPA 200.7	07-02-2004 1351 JJ
Sodium, Dissolved	10.20	0.09	mg/l	EPA 200.7	07-02-2004 1351 JJ
Solids, Total Dissolved	391	30	mg/l	EPA 160.1	06-29-2004 0800 JJ
Sulfate	103	1	mg/l	EPA 300.0	06-29-2004 1325 BLP
Cation/Anion Balance	-4.1	----	%		07-08-2004 1425 SB

EMBER ACIL

Respectfully submitted,
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Huntington Laboratory

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YEAR 2004 CULTURAL RESOURCE MONITORING REPORT FOR SITES WITHIN THE PINES COAL LEASE TRACT, SUFCO MINE, MANTI-LA SAL NATIONAL FOREST

EarthTouch Cultural Resource Rpt. 05-01

by
Lorna Billat and Scott Billat

February 1, 2005

Prepared by
EarthTouch, Inc.
Layton, Utah

For
Canyon Fuel Company
SUFCO Mine
Salina, Utah

Manti-La Sal NFS - MOA: 00-MU-11041000-017

MANAGEMENT SUMMARY

On behalf of Canyon Fuel Company, LLC. (Canyon Fuel), EarthTouch, Inc. has completed the 2004 monitoring program of selected cultural resource sites located within the Pines Coal Lease Tract of the Canyon Fuel Company, SUFCO Mine. These resources are situated near the northern terminus of Old Woman Plateau about six miles northwest of the town of Emery, Utah. The monitoring program was developed as a mitigation measure associated with the approval of the Pines Coal Lease Tract and has been implemented in accordance with the Memorandum of Agreement (MOA) established between the Manti-La Sal National Forest , DOGM, SHPO and Canyon Fuel, the operator of the SUFCO Mine. The monitoring program involves routine field inspection of specifically selected cultural resource properties to record any effects that may have resulted from underground mining activities.

During 2004, five (5) sites were monitored including 42SV2423, 42SV2425, 42SV2430, 42SV2433, and 42SV2434. The results of the monitoring program for 2004 are presented in this report. Of the sites monitored, only site 42SV2430 is found to have been impacted by subsidence, as a direct result of mining activities. Subsidence impacts to the sites included surface cracking, overhang breakage, and some water erosion. None of the remaining sites observed as part of the 2004 monitoring program appeared to have been affected by additional mining subsidence.

TABLE OF CONTENTS

FIGURES AND TABLES

INTRODUCTION

This report summarizes the results and contains the forms for site monitoring that occurred during the year 2004 for the Pines Coal Lease Tract area of the Canyon Fuel Company, LLC., SUFCO mine. The monitoring plan reflects the requested and required information in the Memorandum of Agreement (MOA) between the Manti-La Sal National Forest Service, the Utah State Historic Preservation Office, Canyon Fuel, Utah Division of Oil, Gas, and Mining, and the Advisory Council on Historic Preservation regarding the SUFCO Mine. All tasks will be performed within the standards and guidelines established within the MOA.

The monitoring plan included thirteen cultural resource sites, from a total of 38 sites known to be in the project area. The thirteen sites have been identified as being eligible for the National Register of Historic Places. The 2004 monitoring data includes results from five of the thirteen eligible sites in the project area (Figure 1). Specific findings from the sites are found on the individual site forms in Appendix A.

PROJECT BACKGROUND

In 1999, JBR Environmental completed an EIS of the proposed Pines Coal Lease Tract Project Area at which time a review of the known existing cultural resources was conducted (JBR Environmental Consultants 1999). The cultural resource sites were evaluated for significance and possible impacts that could result from longwall coal mining. At that time 38 cultural resource sites were located in the proposed project area, 13 of which were considered eligible and an additional eight considered unevaluated pending further research. The thirteen eligible sites include eight rock shelters, two campsites, and three lithic scatters. The unevaluated sites are comprised of three lithic scatters, two campsites, and three rock shelters.

POTENTIAL MINING EFFECTS

JBR determined that the proposed longwall coal mining could result in direct impacts to the eligible and unevaluated cultural resource sites. Direct impacts could occur during escarpment failure associated with subsidence induced ground movement, and strata fracturing, as well as increased water supply from a proposed mine water discharge structure. The increased water levels could result in bank or stream terrace erosion or the isolation of the cultural resource from access and additional study.

After evaluating the sites for significance, levels of impact (or severity) were predicted for each site depending on their placement in relation to subsidence activities. Level I impacts consist of up to four feet of subsidence but with little tension or compression. Some erosion is possible due to a very slight sloping of ground. No recommendations are made for cultural resource sites at this level. Level II involves less subsidence with more compression and tension occurring depending on where the site lies within the subsidence trough. Increased compression strains may cause fractures in rock with little or low topography displacement. Level II impacts are likely to be low or minimal to cultural resources. Level III addresses cultural resource sites located on cliff edges, overhangs, or canyon edges. At Level III, subsidence and compression are present with compression strains causing some buckling and/or movement of the rock. Level IV impacts occur at the subsidence trough margins or ends and these areas will sustain permanent displacement, strain, and slope changes.

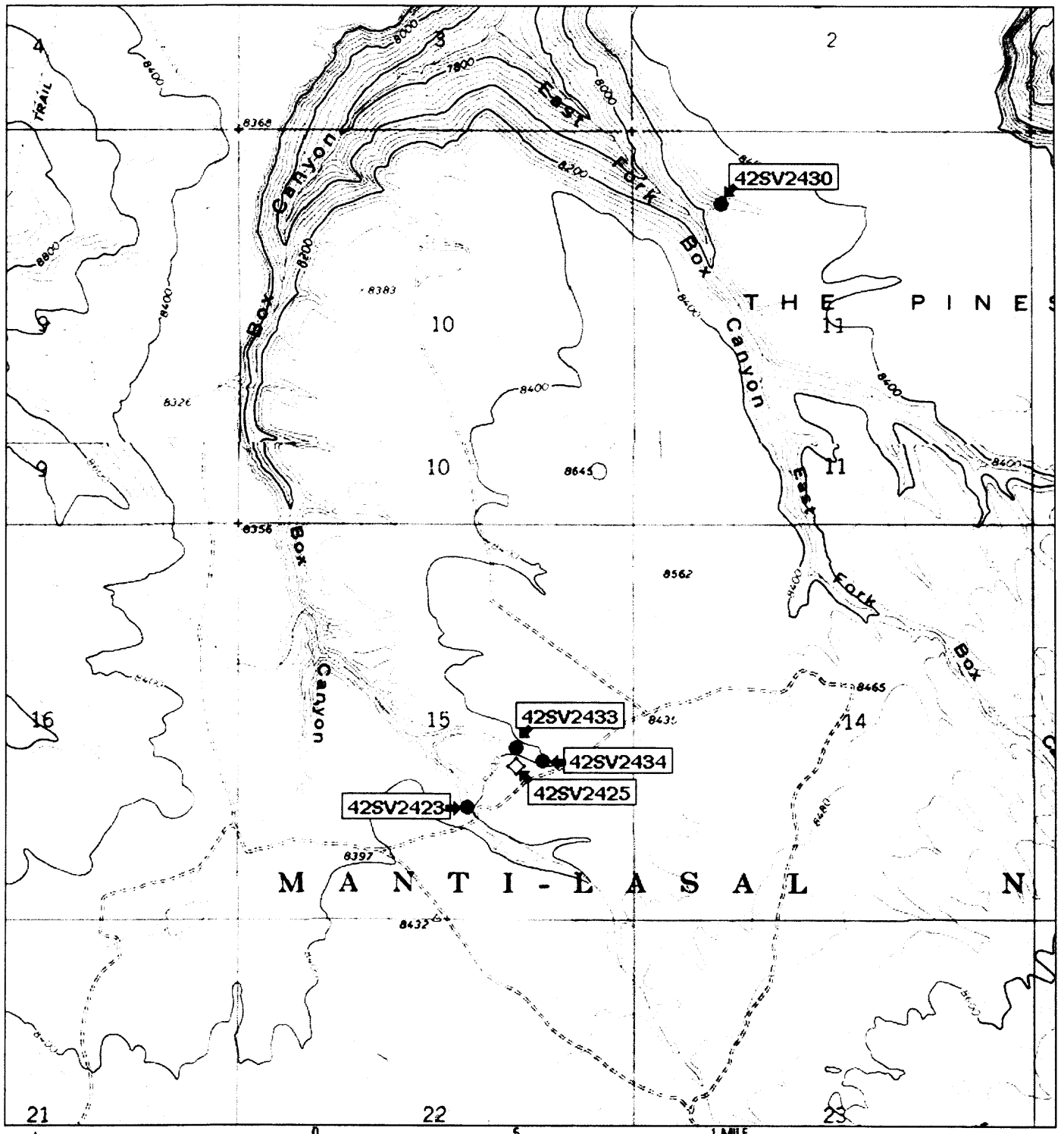


Figure 1

Site Location
Topographic Map

Pines Tract
Monitoring 2004

Figure No:
Appended:

Project Number:
Project Analyst: S. Billat

Date Prepared: Jan 2005
USGS 7.5' Quad: Emery West, Flagstaff Peak, UT

earthTouch
www.earthtouch-llc.com

EarthTouch, Inc.
3135 N. Fairfield Dr.
Layton, Utah 84041
Tel: 801.771.2800

SITE DESCRIPTIONS

Initial cultural resource work was done in the area as early as 1976 when site 42SV896 was recorded by Darrell E. Smith. The majority of the sites included in the monitoring program were recorded between 1996 and 1999 by AERC and many of the original site descriptions have been adapted from the IMAC site forms provided by AERC. Baseline data for monitoring purposes can be found on the monitoring forms in Appendix A. The following descriptions include the original and current appearance of the sites as well as the National Register evaluations.

42SV2423

This site, designated as Refugia Shelter, was originally recorded in 1997 by AERC. It is located in the east branch of Box Canyon near the bottom of the drainage. The site is a rock shelter that is about 20 meters wide and 10 meters deep. It is situated between 15 meters and 20 meters below the rim of the drainage. AERC included the canyon rim above the rock shelter within the designated site boundaries. The rock shelter faces a small sink or basin in the canyon. Artifacts noted at the site at the time of the original documentation included lithic debitage and tools, bone fragments, ground stone (bedrock metate), ceramics, and charcoal. The form indicates that between 25 and 100 chert, quartzite, and chalcedony flakes were observed. Several bifaces were noted on the canyon rim above the rock shelter that are possibly associated with the site. No diagnostic lithic tools were in evidence, however, the ceramics were determined to be Sevier grayware. Based on the ceramics the cultural affiliation is likely to be Fremont with a possible Late Archaic component as well. A pictograph panel including four amorphous elements is on the ceiling of the rock shelter. The AERC form indicated the presence of a midden, a number of grooves noted on a boulder near the back wall, and a looters pit. The interior floor of the rock shelter is described on the AERC form as a flat, stable occupational surface. The previously mentioned looters pit, with its associated artifacts, is located within the interior of the rock shelter. During subsequent visits in 2000 and 2002, sparse flakes, no ceramics, or ground stone were noted at the site, and the interior surfaces of the rock shelter appear to have been somewhat trampled and disturbed by cattle and recent recreational activities. However, the site still meets criterion D as it has the potential to provide substantive data to address questions relevant to chronology, settlement patterns, subsistence, and lithic technology. Therefore the site is recommended eligible for the National Register. During the 2004 monitoring observations this site does not appear to have been affected by mining activities.

42SV2425

This site was recorded by AERC in 1997. It is located on the east side of Box Canyon. The AERC form indicates that the site is a lithic scatter about 30 meters by 90 meters in size. AERC noted two lithic concentrations were present on the site, designated as Unit A and Unit B. Artifacts included chalcedony and chert debitage numbering between 100 and 500 flakes, one biface, one projectile point tip, and a scraper. The projectile point fragment, the biface fragment, and possible scraper were associated with Unit A. There were no tools associated with the smaller Unit B. No ceramics, diagnostic artifacts, or other tools were found. AERC indicated a potential for cultural deposition. In the subsequent visits during 2000 and 2002, no tools were found however, the site is easily accessible to the public and any obvious tools or tool fragments may have been collected. The concentrations described by AERC were not readily visible during later visits, but collection and cattle grazing may be factors in its current more dispersed appearance. The potential for cultural deposition may be reduced to those areas on the site surface that are between the protruding bedrock on the canyon rim terrace. Despite the current lack of tools visible on the surface, the quantity of flakes and potential for other subsurface tools indicates the site meets criterion D of the National Register. The site may have the potential to provide information for addressing research questions relevant

to chronology, settlement, and lithic technology. The site is therefore recommended eligible for the NRHP. During the 2004 monitoring observations this site does not appear to have been affected by mining activities.

42SV2433

The site, designated as Big Mac Shelter, was recorded in 1997 by AERC. The site is a small rock shelter situated at the head of a tributary drainage of Box Canyon. The site area, including the rock shelter, is ten meters by six meters. No surface features were noted in the rock shelter. Only two artifacts were observed at the site. These included two pottery fragments that are possibly attributable to the Fremont. During site visits in 2001 and early 2002, the interior of the rock shelter appeared to have sustained rodent damage and/or looting. Sedimentary deposits within the rock shelter are intact, except along the drip line where water has exposed the bedrock. This site was initially deemed unevaluated, by AERC in 1997, pending further testing and data on the subsurface soil deposits. This site was impacted by subsidence activity in the spring of 2002 and new impacts appeared to have occurred in 2003. The impacts will be detailed below in the "Monitoring Observations" section.

42SV2434

This site, named Little Mac, was originally recorded by AERC in 1997. The site is a moderate size rock shelter situated just east of site 42SV2433, near the head of a side drainage in Box Canyon. The rock shelter is nine meters by five meters in size, with a low ceiling of between one and one and one half meters in height. No surface features were noted in the rock shelter. Two ground stone fragments and a biface were found within the rock shelter in 1997. Cultural deposits as described by AERC were intact, except along the drip line where water exposed the bedrock. During site visits in 2001 and early 2002, the interior of the rock shelter appeared to have sustained minimal rodent activity and/or looting. This site was initially deemed unevaluated, by AERC in 1997, pending further testing and data on the subsurface soil deposits. This site was impacted by subsidence activity in the spring of 2002 and new impacts appeared to have occurred in 2003. The impacts will be detailed below in the "Monitoring Observations" section.

42SV2430

The site, named Elusive Peacock Shelter, was originally recorded in 1997 by AERC. This moderate-sized rock shelter is situated within a steep side drainage in the northern portion of the East Fork Box Canyon. The rock shelter is in one of two overhangs that are situated almost directly over each other in the side canyon. The rock shelter formed by the uppermost overhang has been utilized for prehistoric occupation. The upper rock shelter is 15 meters deep and 30 meters across. AERC noted a variety of artifacts within the rock shelter including lithic debitage, ground stone, fire-cracked rock, scattered faunal bone, and possible hearth remnants. One chert core tool and a small piece of ground stone were noted on the site surface. No diagnostic artifacts were evident. A looters pit spoil pile noted in 1997 contained burned stone, flakes, and charcoal. There is a potential for substantial cultural deposition within the rock shelter. During the site visit in 2002, sparse artifacts were noted on the surface. There appears to have been considerable recreational activity on top of the rim above the rock shelter as well as within the feature. Collection within the rock shelter is likely to have occurred. There are at least two looters pits noted within the rock shelter. Scattered bone and charcoal are on the current site surface. The lower overhang may have functioned as a good location for obtaining water. The interior is very wet with dense mud deposits forming the surface and natural springs seeping down the back wall of the overhang. The site meets criterion D for its potential to provide substantive information about prehistoric occupation of the canyon and addressing research questions about settlement, lithic technology, and water retention practices. Despite obvious looters pits there is a still a likelihood of buried cultural deposits in the upper rock shelter. The site is therefore considered eligible for the National Register. During the 2002 monitoring observations this site does not appear to have been

affected by mining activities.

METHODS

The overall procedures for implementing the monitoring plan for this project, are based on the MOA established by the Manti-LaSal NFS (No. 00-MU-11041000-017). Before site monitoring took place in the Pines Coal Lease Tract Project area, a site monitoring form was created to consistently assess the identified sites. With input from the Manti-LaSal NFS and Scott Billat, the monitor forms were created that included the following main categories. These consist of the anticipated effects of subsidence, site condition (including human and animal impacts, etc.), and natural impacts (including cracking, slumping, etc.). Notations for reference points are also included such as those for total station measurements, datums, and photographs (see the monitoring forms for specific details).

Methods established in the monitoring plan will be implemented during each cultural resource site visit and include: completing the monitoring form for each site, utilizing a TopCon Total Station to record vertical and horizontal measurements that document subsidence movement (sites not impacted by subsidence), establishing datum (s) points, and taking photographs.

MONITORING SCHEDULE

Three monitoring schedules were proposed for the SUFCO mine. These schedules were established according to the MOA with the Manti-LaSal National Forest Service. The proposed schedules are discussed below:

(1) Schedule A involves sites 42SV2423, 42SV2425, and 42SV2432, all located in areas that will be subsurface mined using full support methods or are close to an area being mined. Sites will be monitored as follows: (a) an initial monitoring six months prior to mining to provide a control; (b) one monitoring visit within six months of the onset of subsidence, and one monitoring between six and twelve months after the initiation of subsidence; and (c) one monitoring one time per year for two additional years. If subsidence has not ceased at the end of two years, monitoring will continue at the rate of one visit per year until there is no further ground movement.

(2) Schedule B includes sites 42SV2492, 42SV2430, 42SV2433, 42SV2434, and 42SV2341, all located in areas that will be mined under and subsided. These sites will be monitored as follows: (a) one initial monitoring six months prior to mining to provide a control; (b) monitoring once per month during the first six months after the onset of active subsidence, and then once every three months during the period between six and twelve months after the onset of active subsidence; and (c) one monitoring one time per year for two additional years. If subsidence has not ceased at the end of two years monitoring will continue at the rate of one time per year until there is no further ground movement.

(3) Schedule C will involve sites 42SV896, 42SV2386, 42SV2387, 42SV2388 and 42SV2389, which are located in areas undermined prior to the MOA from June 1998 thru July 1999 and were covered under a separate Quitchupah Tract approved mine plan. Sites will be monitored once per year for at least two years until subsidence is complete and there is no more ground movement.

Based on the above program design, the following schedules was implemented for monitoring sites during the year 2004:

April	Monitoring of sites 42SV2433 and 42SV2434
	Monitoring of sites 42SV2423and 42SV2425
September	Monitoring of site 42SV2430

MONITORING OBSERVATIONS

Each site noted on the above schedule for 2004 was monitored and evaluated to assess the possible effects that may result from subsidence. Control information was recorded at each site, and reference points were established at each site in order to measure effects of mining activity. Criteria were established with which to judge human, animal, and/ or natural activity in and near the sites, and to determine the extent of impact that these activities may, or may not have, on the sites. Changes in site conditions resulting from mining activities as well as recent evidence of animal, natural, and other human impacts are presented in Table 1.

Five sites were monitored and evaluated during the 2004 monitoring program. Of the five sites assessed, one site, 42SV2430, has sustained additional impacts from mining subsidence activities during late 2003, and no additional subsidence damage has occurred to sites 42SV2433 and 42SV2434 since 2002. The other two sites exhibited minor to no changes from natural or human impacts. A summary of the results can be viewed in Table 1. Specific information for the sites is presented from each monitor form in Appendix A. Monitoring assessment of the sites with damage as a result of subsidence are found below. The damage reports from 2002 and 2003 are included for convenience of transition into 2004.

Assessment of Site 42SV2423
During subsequent visits in 2000 and 2002, sparse flakes, no ceramics, or ground stone were noted at the site, and the interior surfaces of the rock shelter appear to have been somewhat trampled and disturbed by cattle and recent recreational activities. However, the site still meets criterion D as it has the potential to provide substantive data to address questions relevant to chronology, settlement patterns, subsistence, and lithic technology. Therefore the site is recommended eligible for the National Register. During the 2004 monitoring observations this site does not appear to have been affected by mining activities.

Assessment of Site 42SV2425
Despite the current lack of tools visible on the surface, the quantity of flakes and potential for other subsurface tools indicates the site meets criterion D of the National Register. The site may have the potential to provide information for addressing research questions relevant to chronology, settlement, and lithic technology. The site is therefore recommended eligible for the NRHP. During the 2004 monitoring observations this site does not appear to have been affected by mining activities.

Assessment of 42SV2433
Damage report from 2002 - Mining activity near site 42SV2433 appears to have caused damage to the rock shelter. While some natural spalling of rock was evident at the site prior to mining activities in the area, the majority of rock now covering the front interior surface of the rock shelter appears to be a direct result of subsidence. Several large rock fragments cover the front interior surface of the rock shelter. This rock exhibits evidence that it separated from the bedrock roof of the rock shelter in a single 25 foot long section

that broke apart when it landed on the rock shelter interior surface. The rock rubble forms a four feet high stone wall across the front of the rock shelter. Conversely, only a thin layer of sandstone has fallen at the back of the rock shelter, leaving the central interior of the rock shelter void of rock. Two one-inch wide, east-west oriented cracks are located , 1) in the ground surface above the rock shelter, and 2) along the top of the rock shelter in the drainage channel. Both cracks appear to be of recent origin. The rock fragments across the front interior of the rock shelter and the two surface cracks were not evident in the original documentation of the site, supporting the contention that they are a result of subsidence. The natural water runoff route is over the top of the rock shelter and down into the drainage. The drainage spillway is aligned with the now damaged portion of the rock shelter. The potential for further damage to the interior of the rock shelter is likely to occur through water erosion.

Damage report from 2003 - Mining activity near the site appears to have caused additional rock fall across a ten foot wide area in the rock shelter interior, particularly at the middle interior. Most of the interior floor of the rock shelter is no longer visible. The very back recesses of the rock shelter floor may be accessible however, the roof of the structure is now thinner with minimal stability. The large east-west oriented crack on the north side of the rock shelter has expanded in width since 2002. The front interior area of the rock shelter does not appear to have sustained additional damage from water erosion.

Damage report from 2004 - Inspection of the rock shelter indicated that its condition primarily remains the same as noted in 2003. The central portion of the rock shelter may have some minor additional ceiling spalling. The roof area was initially fractured, enabling thin slab pieces to be spalled from the ceiling and pile onto the thick debris accumulated on the floor. Overall, the main roof fall block debris appears to be the same. The main cracks along the top of the shelter in the bedrock appear to be the same in size. Water erosion still appears to be minimal, as the fallen roof debris protects the overall floor area of the shelter below the drainage channel. No other movement or damage was apparent at the site.

Assessment of 42SV2434

Damage report from 2002 - Subsidence in the vicinity of site 42SV2434 appears to have resulted in damage to the rock shelter. Although some natural spalling of rock was evident at the site prior to mining activities in the area, the majority of the rock now covering the interior surface of the rock shelter appears to be a direct result of subsidence. Two large fragments of rock, one measuring 15 feet by 15 feet and one approximately six feet in length, cover the interior surface of the rock shelter. These fragments exhibit evidence that they have recently fallen from locations associated with the bedrock that formed the roof of the rock shelter. A one-inch wide, east-west oriented crack located in the ground surface above the rock shelter also appears to be of recent origin. The two rock fragments and the surface crack were not evident in the original documentation of the site, supporting the contention that they are a result of subsidence. Originally, minimal erosion occurred at the site, primarily in the form of moisture seepage. With the recent collapse of the overhang, the interior of the rock shelter is now increasingly vulnerable to water runoff.

Damage report from 2003 - Mining activity near the site appears to have caused additional rock spalling from the southern edge of the rock shelter. More smaller rocks have eroded off the roof edge and fallen into the interior of the rock shelter. There is evidence of some water damage from the drainage inflow to the rock shelter due to run-off and thunderstorms. Water has apparently dropped into the rock shelter with minimal to no outflow area visible. The rock fall within the interior and at the front of the rock shelter appears to prevent the water from efficiently exiting, thus the water is pooling in the interior. There is no visible water channeling in front of the shelter.

Damage report from 2004 - Inspection of the rock shelter indicated that its condition primarily remains the same as that from 2003. Some soil erosion appears to be present along the top edge, above the rock shelter, at its break line. The interior rear portion of the rock shelter is still standing. While no pooled sediments from water erosion were observed within the interior or on the outside of the rock shelter, the floor of the rock shelter is susceptible to heavy water runoffs. Silty and sandy soils, along with small broken rock cover the interior and rear half of the rock shelter.

Assessment of 42SV2430

Damage report from 2004 - After the initial baseline documentation of this site in 2002, undermining of the site was conducted in November 2003, which caused the rock shelter to collapse. Subsequent to the mining subsidence beneath the site area, representatives from Canyon Fuel conducted a site visit during the winter months. Photographs taken of the site indicate substantial damage to the rock shelter. Most of the terraced hillside containing the site rock shelter had collapsed. The monitoring visit to the site in June 2004 , was the first time the site was inspected within the annual schedule by EarthTouch personnel. Approximately six months had passed since the Canyon Fuel inspection in the winter and the mining subsidence activities beneath the site area. The monitoring inspection of the site appear to indicate that more damage had occurred since the winter visit by Canyon Fuel. Based on the initial photos taken of the site by Canyon Fuel, right after its initial collapse in late 2003, the remaining hillside containing the site had broken off the terrace. No evidence of what was once the rock shelter location was visible from a semi-stable vantage point, just south of the site. The entire immediate area around the site has not been stable or safe enough for closer inspection. The location of the site consists of boulder rubble and fallen trees, piled and strewn on the hill slope.

CONCLUSIONS

Five sites were monitored and evaluated during the 2004 monitoring period. Of the five sites, only one (42SV2430) appears to have sustained additional damage as a result of subsidence during the fall of 2003 and the early part of 2004. The other four sites exhibited minor to no changes from natural or human impacts. These include sites 42SV 2423, 42SV2425, 42SV2433, and 42SV2434.

Damage as a result of subsidence at site 42SV2430 has led to the collapse of the entire rock shelter, as well as the slope in the immediate project area. Essentially the rock shelter no longer exists and the surrounding associated area is very unstable. None of the other sites including 42SV2423, 42SV2425, 42SV2433, and 42SV2434 appear to have sustained impacts from mining related activities.

Table 1. Summary of Monitoring Criteria and Effects on Year 2004 Sites.

SITE NUMBER	HUMAN DAMAGE						ANIMAL DAMAGE			NATURAL DAMAGE					CHANGES FROM SUBSIDENCE
	Illegal Excavation	Graffiti	Unintentional Damage				Livestock Trails	Livestock Wallows	Rodent Burrowing	Water Erosion	Geologic Structure				
			Footprints	Trail / Footpath	Camping	Trash					Block Failure	Surface Cracking	Slumping	Slide Deposits	
42SV2423	yes		yes	yes		?									no
42SV2425	no														no
42SV2433	no		no								yes	yes	yes		No/minimal
42SV2434	no		no	no		no	no			some	yes	yes	yes		No/minimal
42SV2430	no		no	no			no				yes	yes	yes	yes	yes

APPENDIX A - MONITORING FORMS AND PHOTOGRAPHS

SUFCO SITE MONITORING FORM

--Pines Tract--

1)Site No.: 42SV2423 Field Date: June 2004

Schedule: A

2) Anticipated effects from subsidence

a) General Effects as in EIS: Longwall coal mining causes a number of geological stresses on the landscape during and after mining is completed. The stress factors of subsidence consisting of compression and tension, can lead to tension cracks and escarpment failure in the canyons and rock outcrops. Based on the data compiled by Agapito and Associates for the project, four levels of impact have been identified that relate to the degree of subsidence at a given location.

b) Specific Anticipated Effects during and after:

3) Condition Assessment

a) Baseline condition: This site, designated as Refugia Shelter, was originally recorded in 1997 by AERC. It is located in the east branch of Box Canyon near the bottom of the drainage. The site is a rock shelter that is about 20 meters wide and 10 meters deep. It is situated between 15 meters and 20 meters below the rim of the drainage. AERC included the canyon rim above the rock shelter within the designated site boundaries. The rock shelter faces a small sink or basin in the canyon. Artifacts noted at the site at the time of the original documentation included lithic debitage and tools, bone fragments, ground stone (bedrock metate), ceramics, and charcoal. The form indicates that between 25 and 100 chert, quartzite, and chalcedony flakes were observed. Several bifaces were noted on the canyon rim above the rock shelter that are possibly associated with the site. No diagnostic lithic tools were in evidence, however, the ceramics were determined to be Sevier grayware. Based on the ceramics the cultural affiliation is likely to be Fremont with a possible Late Archaic component as well. A pictograph panel including four amorphous elements is on the ceiling of the rock shelter. The AERC form indicated the presence of a midden, a number of grooves noted on a boulder near the back wall, and a looters pit. The interior floor of the rock shelter is described on the AERC form as a flat, stable occupational surface. The previously mentioned looters pit, with its associated artifacts, is located within the interior of the rock shelter. During subsequent visits in 2000 and 2002, sparse flakes, no ceramics, or ground stone were noted at the site, and the interior surfaces of the rock shelter appear to have been somewhat trampled and disturbed by cattle and recent recreational activities. No additional looting or impacts from mining subsidence were noted during the June 2004 visit.

b) Current condition: No changes were noted in the June 2004 visit.

b.1) Illegal excavation: (check) present X absent

Describe ___Almost the entire rock shelter interior area has been impacted by foot traffic, looting, or rodent depressions, and back dirt piles. Along the eastern wall of the shelter there is evidence of illegal excavation. One of the looter depressions contained a bisected ash lens, that has since been filled with sediment. There is an obvious depression running north/south along the east interior wall and is 1.4 meters by 0.35 meters in size. Upon closer examination, it appears that there are disturbed sediments along the entire back wall. Proceeding from the north end to the south end of the interior of the shelter, a distance of approximately 16 meters, there are two possible looter holes that have been partially filled and there are large rocks around the depressions. The central depression is about 1.5 meters by 1meter in size, and contains darker soil to the south portion of the rock shelter interior and lighter soil to the east towards the back wall. Also, another small pit or looters hole is situated nearby and is 60 cm by 40 cm in diameter. There is little to no evidence of additional looting in the shelter in June 2004.

b.2) : Graffiti (check) present ___X__ absent_____

Describe __There are modern rock drawings above the rock shelter, where the drainage starts through the bedrock. No changes appear to have made to the shelter since the 2000 visit.

b.3) : Unintentional damage:

b.3.1) Footprints (check) present __X__ absent_____

b.3.2) Trail/footpath (check) present __X__ absent_____

A trail comes from the top of the canyon down into and throughout the rock shelter at the base of the cliff.

b.3.3) Camping on or near (check) present_____ absent __X__

Describe __None_____

b.3.4) Recent trash (check) present __X___ absent_____

Describe __Debris noted in the rock shelter interior includes about 10 pieces of broken clear and amber glass, along with rabbit and deer bone. There are two 55-gallon drums located in the water pond area. A measuring rod is hooked to a 'T' post in the water on 1/4 inch metal cable. Additional trash noted during the April 2003 site visit included more broken glass, cigarettes, and smashed beer cans. No trash noted during 2004 visit.

3b.4) Animal damage:

b.4.1) Livestock trails (check) present ___X____ absent_____

Describe __The trail comes from a clearing and encircles the pond. Hoof prints and cow manure are present on the west part of the overhang. There is no specific evidence of cows in the cultural area of the rock shelter.

b.4.2) Livestock wallows (check) present_____ absent ___X____

Describe __None_____

b.4.3) Rodent burrowing (check) present ___X__ absent_____

Describe __More animal diggings are visible at the center back of the rock shelter and along the west side wall.__

3.b.5)Natural Damage

b.5.1) Water erosion (check) present ___X__ absent_____

Describe ___Both Cracks 3 and 4 exhibit water seepage. There are water drip marks and wet soil along the entire back portion of the culturally filled area beneath the overhang. There is a main drainage that runs from on top with a few water pockets and pools, which then runs over the western and southern part of the overhang, and west of the shelter where the cultural material is present. The drainage then drops into a small circular pond or pool that is roughly 8 meters in diameter. Water erosion appears to remain the same in June 2004. Water seepage is more evident likely because of spring run-off. Ferns are growing in the cracks at the rear and roof interior of the rock shelter.

b.5.2) Geologic structure

A) Block failures:

Describe __The cracks described below are naturally occurring faults on the site surface. Crack 1 runs above the center exterior of the rock shelter and is the easternmost crack. It extends approximately 25 meters across the overhang. Crack 2 begins at the top of the rock shelter and extends about 10 meters down, continuing to the east, and connects with Crack 1. Crack 3is on the overhang that is west of the rock shelter. It is deep and extends down from the surface. Water seepage in the crack accommodates the growth of algae, mosses, and ferns. then it is apparent the roof of the shelter and continues to the back of the shelter. A 'Y' branch is formed as the crack begins into the shelter. The major crack runs to the south while the other branch turns to the east. Crack 4 is west of the rock shelter and Crack 3. It is also west and southwest of the water collection area. It runs from the top of the surface above the shelter all the way down to the bottom of the shelter. At present there is a large stone block between Cracks 3 and 4. Crack 5 is located west of Crack 4 and west of the central drainage. Crack 6 is just east of Crack 1. Crack 6 is deep and passes down the face of the bedrock to the base of the rock shelter. It is about 5-10 feet east of the shelter and about 8-10 feet parallel and east of Crack 1. No additional cracks or faults were noted in the August 2002 visit. None of the above mentioned cracks had indications of expansion or movement from the mining subsidence that occurred in the area in since 2002.

B) Surface cracking:

Describe __See above_____

C) Slumping:

Describe __None_____

D) Slide deposits:

Describe None

4. Assessment of Effects

4a) NRHP: During subsequent visits in 2000 and 2002, sparse flakes, no ceramics, or ground stone were noted at the site, and the interior surfaces of the rock shelter appear to have been somewhat trampled and disturbed by cattle and recent recreational activities. However, the site still meets criterion D as it has the potential to provide substantive data to address questions relevant to chronology, settlement patterns, subsistence, and lithic technology. Therefore the site is recommended eligible for the National Register. During the 2004 monitoring observations this site does not appear to have been affected by mining activities.

4b)Natural/Human effects (see section 3): In summary, the rock shelter interior floor surface has been disturbed by human traffic, livestock, and to a greater extent, looting. It appears the subsurface looting has impacted cultural deposits. Six large natural block cracks are evident above and adjacent to the rock shelter. These block cracks have not yet been altered or expanded by mining subsidence. Some historic usage of the canyon bottom area may have impacted the rock shelter area. The immediate site location contains a small spring fed pond. Due to its location, the nature of the site (a natural shelter), and the presence of water, the site will continue to receive on-going human traffic. No additional alterations, lootings, or mining subsidence appear to have occurred since the 2000 monitoring visit.

5) Movement- Datum nail points: Total station setup: 115cm (height)

---All METRIC---- (Top of datum to tripod plane)

Datum point #1: Vertical 87 09' 07" Horizontal: 84 03' 22"

Vert. Dist. 1.116 Horz.Dist. 22.534

Datum point #2: Vertical 90 40' 53" Horizontal: 88 34' 23"

Vert. Dist. -0.288 Horz.Dist. 23.871

Datum point #3: Vertical 87 47' 51" Horizontal: 97 59' 30"

Vert. Dist. 0.882 Horz.Dist. 23.103

Datum point #4: Vertical 93 25' 58" Horizontal: 124 49' 16"

Vert. Dist. -0.868 Horz.Dist. 20.222

Datum point #5: Vertical 90 07' 30" Horizontal: 84 24' 15"

Vert. Dist. -0.042 Horz.Dist. 0.839

Datum point #6: Vertical 90 12' 25" Horizontal: 96 55' 59"

Vert. Dist. -0.094 Horz.Dist. 25.541

SUFCO Point : Vertical 59 18' 20" Horizontal: 91 18' 09"

Vert. Dist. 15.711 Horz.Dist. 26.378

Photography: (see site map) SUFco Monitoring Roll# June Date June 2004

Site # 42SV2423

Shot# 28 Point Photo #1 : Angle view 35 mm Degree Dir. 155

Descr.

Shot# 25 Point Photo #2 : Angle view 35 mm Degree Dir. 90

Descr.

Shot# 24 Point Photo #3 : Angle view 35 mm Degree Dir. 45

Descr.

Shot# 30 Point Photo #4 : Angle view 35 mm Degree Dir. 70

Descr.

Shot# 27 Point Photo #5 : Angle view 35 mm Degree Dir. 95

Descr.

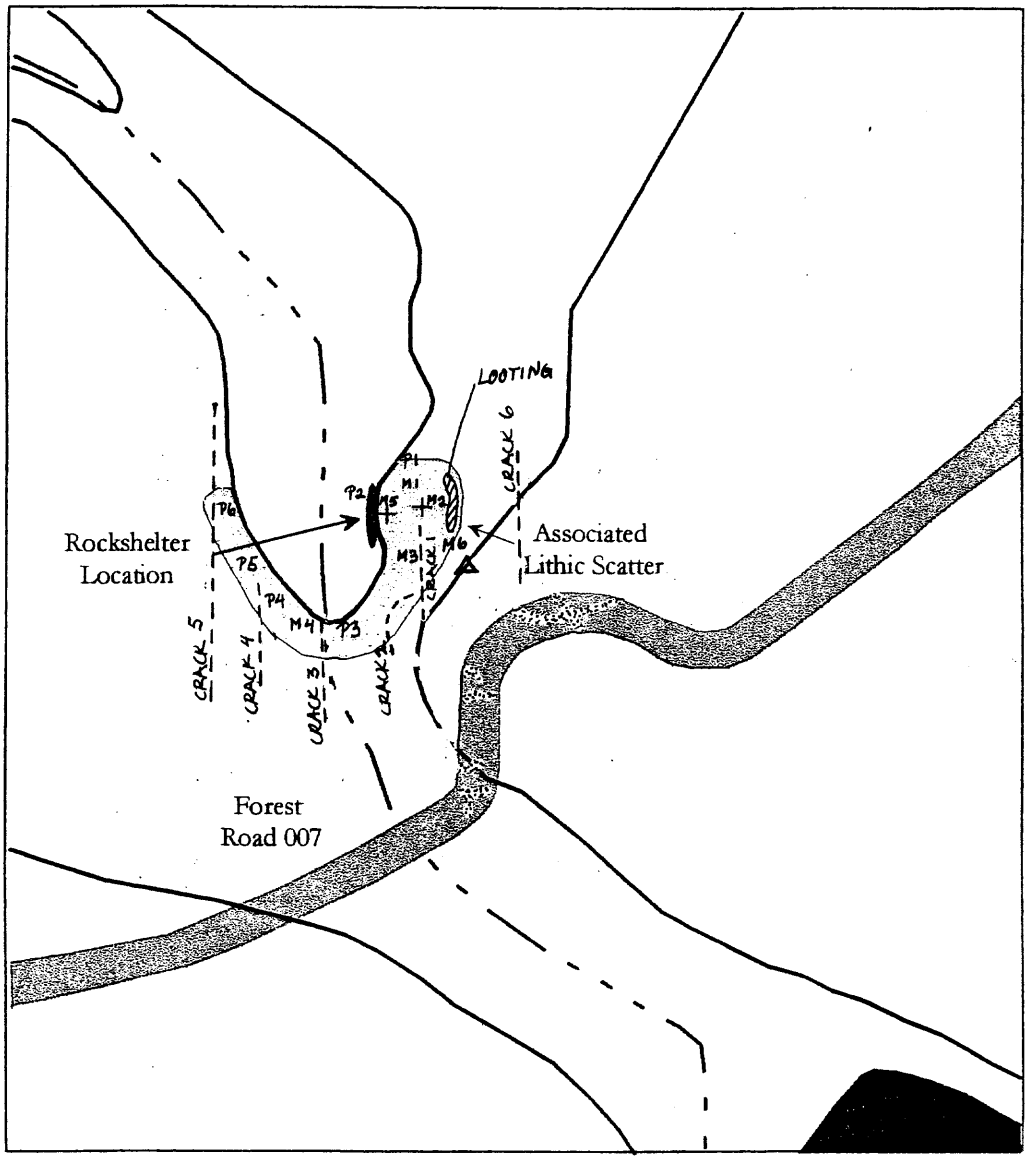
Shot# 29 point photo #3 : Angle view 35 mm Degree Dir. 45

Descr. another shot

Shot# 30 : Angle view - mm Degree Dir.

Descr. General view of the rock shelter

MAP 3: 42SV 2423 SITE MAP



Scale (in feet)

* The contour interval is 40 feet

0 200 400 600

Δ SUFCO DATUM POINT
M - MOVEMENT POINT
P - PHOTO POINT

Legend

+ Sevier Gray Ware Fragment

Extent of Lithic Scatter

Intermittent Stream

N

42SV2423

SUFCo SITE MONITORING FORM

--Pines Tract--

1) Site No.: 42SV2430 Field Date: June 2004

Schedule: B

2) Anticipated effects from subsidence

a) General Effects as in EIS: Longwall coal mining causes a number of geological stresses on the landscape during and after mining is completed. The stress factors of subsidence consisting of compression and tension, can lead to tension cracks and escarpment failure in the canyons and rock outcrops. Based from the data compiled by Agapito and Associates for the project, four levels of impact have been identified that relate to the degree of subsidence at a given location.

b) Specific Anticipated Effects during and after: This site has been placed into Level III. Level III addresses cultural resource sites that are located on cliff edges, overhangs, or canyon edges. At level III, subsidence and compression are present with compressional strains possibly causing some buckling and/or movement of the rock. At this level of impact, it is recommended that the mining takes place.

3) Condition Assessment

3a) Baseline condition: The shelter is in good condition as far as the structure and bedrock make up. Likely human looting of fill appears to be the most impacting to the shelter. Some of the holes in the fill of floor could be from animals. Random digging in past years primarily cover the floor in the first 70% of shelter. Broken rock has been dug up and scattered. The back dirt from the holes appears to scattered across floor area and not piled. It also appears that little cultural material or ash has been exposed from the digging. Fill deposits are likely 80-100 cm deep. Overall, the rockshelter is in good condition, as far as its geologic structural make-up. There has been no natural movement of the shelter roof or terrace face of the sandstone.

3b) Current condition

3b.1) Illegal excavation: (check) present X absent

Describe Two possible looting holes, not recent about 1 meter in size, one in the north side of the shelter and in the central south portion of the shelter. These looting holes appear to be older, likely five years or more. No buried features or artifacts have been exposed within the looting holes.

3b.2) : Graffiti (check) present_____ absent ___X__
Describe __None_____

3b.3) : Unintentional damage:
b.3.1) Footprints (check) present __X_____ absent_____
b.3.2) Trail/footpath (check) present___X_____ absent_____

b.3.3) Camping on or near (check) present_____ absent ____X___
Describe __None_____

b.3.4) Recent trash (check) present_____ absent ____X____
Describe __None_____

3b.4) Animal damage:
b.4.1) Livestock trails (check) present_____ absent __X___
Describe __None_____

b.4.2) Livestock wallows (check) present_____ absent ___X____
Describe __None_____

b.4.3) Rodent burrowing (check) present __X___absent_____
Describe __There are two rodent holes at the rear of the shelter. (1) Large hole about 50 cm at opening. (2) Small hole about 20 cm at opening. There are also significant quantities of bat droppings at the north and south-central front of edge of the terrace. Crevices are evident above the dropping locations indicating the bat access into the ledge.

3.b.5)Natural Damage
b.5.1) Water erosion (check) present __X___ absent_____
Describe __There is water erosion on the north side of shelter and some seepage noted on the rear wall of the shelter. Overall, water erosion is minimal.

b.5.2) Geologic structure
A) Block failures:
Describe There is a long crack on the front edge of the shelter, starting on the south side of the shelter. It spans 3/4 of the shelter. It is primarily a vertical crack, that is open and distinct. There no evidence of vertical movement. The crack is the widest within the rockshelter.

becoming tighter as it proceeds up to the top of the shelter. There is a second crack that is not open, just visible on the sandstone face. It starts on the south side and proceeds to the face of the shelter. A third horizontal crack is on the north interior extending from the rear of the shelter to the face. With the exception of the first crack, the other two cracks are tight and are more associated with the original formation of the sandstone structure.

Damage report from 2004 -After the initial baseline documentation of this site in 2002, undermining of the site was conducted in November 2003, which appears to have caused the rock shelter to collapse. Subsequent to the mining subsidence beneath the site area, representatives from Canyon Fuel conducted a visit to the site location during the winter months. Photographs taken of the site indicate substantial damage to the rock shelter. Most of the terraced hillside containing the site rock shelter had collapsed. The monitoring visit to the site in June 2004 , was the first time the site was inspected within the annual schedule by EarthTouch. Approximately six months had passed since the Canyon Fuel inspection in the winter and the mining subsidence activities beneath the site area. The monitoring inspection of the site appear to indicate that more damage had occurred since the winter visit. Based on the initial photos taken of the site by Canyon Fuel, right after its initial collapse in late 2003, the remaining hillside containing the site had broken off the terrace. No evidence of what was once the rock shelter location was visible from a semi-stable vantage point, just south of the site. The entire immediate area around the site has not been stable or safe enough for closer inspection. The location of the site consists of boulder rubble and fallen trees, piled on the hill slope.

B) Surface cracking:
Describe None

C) Slumping:
Describe None

D) Slide deposits:
Describe None

4. Assessment of Effects
4a) NRHP: This site was originally deemed eligible for the NRHP. At that time, it was estimated that 75% of the cultural deposits may be intact in the rockshelter. Also, these deposits may offer data on Archaic and Formative occupation for the area.

4b)Natural/Human effects (see section 3): Originally, the site was reported to have small amounts of charcoal, a deer jaw, a rib bone fragment, and other small rodent bones present on the shelter floor silt. Also, two possible looting holes were noted on the floor. Overall, the

shelter fill is relatively intact and stable from natural and human activities. Because of its remote location and position in the canyon wall, this site remains in good condition.

5) Movement- Datum nail points: Total station setup: ___cm (height)

---All METRIC---- Collapsed ____

Datum point #1: Vertical _____ Horizontal:_____

Vert. Dist._____ Horz.Dist. _____

Datum point #2: Vertical ____ Horizontal: _____

Vert. Dist._____ Horz.Dist. _____

Datum point #3: Vertical ____ Horizontal:_____

Vert. Dist. _____ Horz.Dist. _____

Datum point #4: Vertical _____ Horizontal: _____

Vert. Dist._____ Horz.Dist._____

SUFCO : Vertical __Not visible from datum__ Horizontal:_____

Vert. Dist._____ Horz.Dist. _____

Photography: (see site map) SUFco Monitoring Roll# __June__ Date _2004

Site # _42SV2430____

Shot# __60__Point Photo -none : Angle view __35____mm Degree Dir

Descr. View north

Shot# __61__Point Photo -none : Angle view __35____mm Degree Dir.

Descr. _View northeast

Shot# __62__Point Photo -none : Angle view __35____mm Degree Dir. _

Descr. View north

Shot# __64__ Point Photo-none : Angle view __35____mm Degree Dir.

Descr. __View north

Shot# __65__ Point Photo -none : Angle view __35____mm Degree Dir.

Descr. View north

Shot# __69__ Point Photo -none : Angle view __35____mm Degree Dir.

Descr. View north

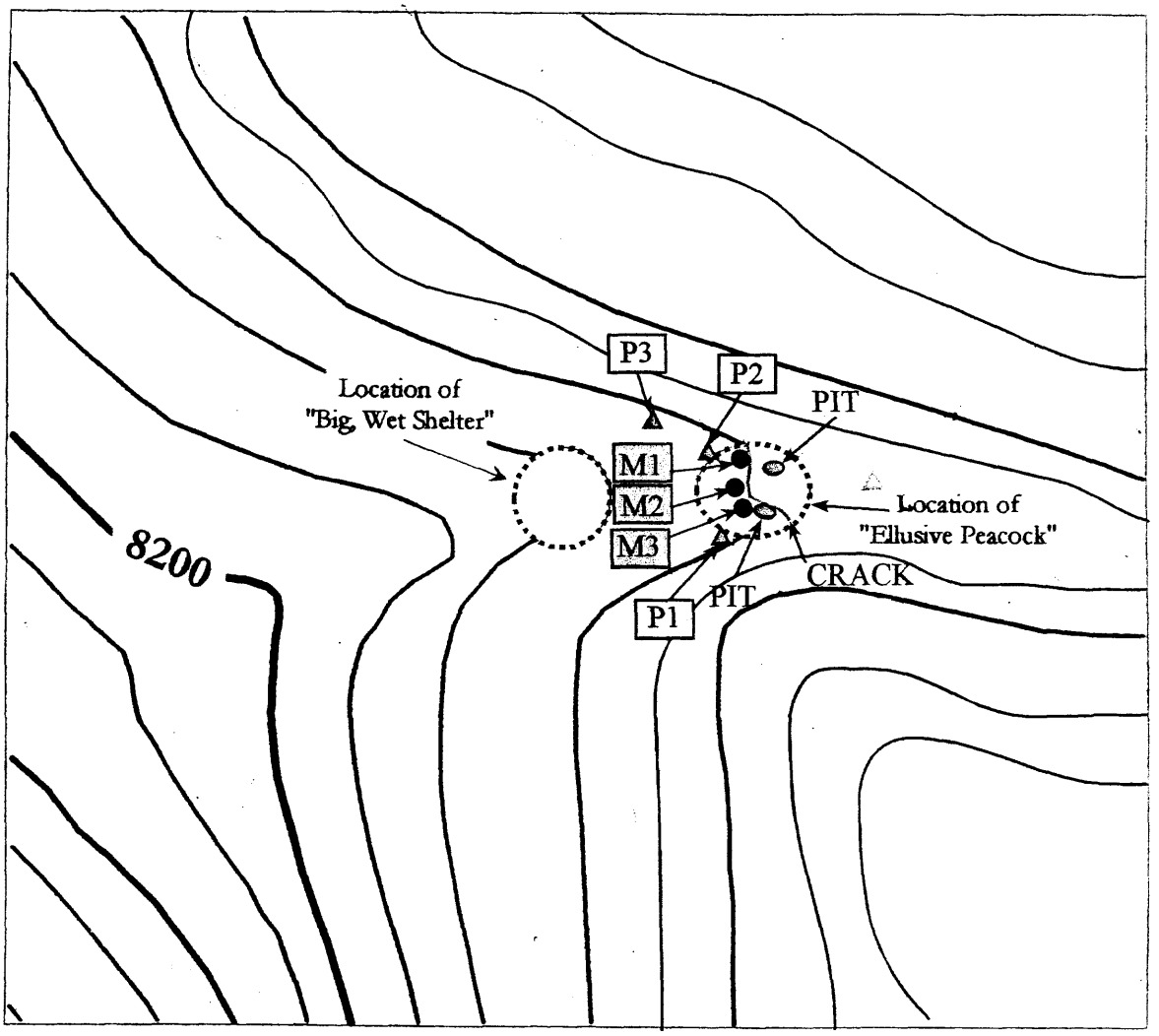
Shot# _70___ Point Photo-none : Angle view __35____mm Degree Dir.

Descr. View north

Shot# __72__Point Photo -none : Angle view _____mm Degree Dir.

Descr. ___Large crack on top of plateau above site

MAP 10: 42SV 2430 SITE MAP



Scale (in feet)

* The contour interval is 40 feet

0 100 200

N

Legend

- MOVEMENT POINT
- PHOTO POINT
- DATUM
- SUFCO DATUM POINT

Rockshelter Location

The East Fork of Box Canyon

42SV2430

SUFCO SITE MONITORING FORM

--Pines Tract--

1)Site No.: 42SV2433 (Big Mac) Field Date: June 2004

Schedule: B

2) Anticipated effects from subsidence

a) General Effects as in EIS: Longwall coal mining causes a number of geological stresses on the landscape during and after mining is completed. The stress factors of subsidence consisting of compression and tension, can lead to tension cracks and escarpment failure in the canyons and rock outcrops. Based on the data compiled by Agapito and Associates for the project, four levels of impact have been identified that relate to the degree of subsidence at a given location.

b) Specific Anticipated Effects during and after: This site has been placed into Level III. Level III addresses cultural resource sites that are located on cliff edges, overhangs, or canyon edges. At Level III, subsidence and compression are present with compressional strains possibly causing some buckling and/or movement of the rock. At this level of impact, it is recommended that the mining takes place.

3) Condition Assessment

3a) Baseline condition: The site, designated as Big Mac Shelter, was recorded in 1997 by AERC. The site is a small rock shelter situated at the head of a tributary drainage of Box Canyon. The site area, including the rock shelter, is ten meters by six meters. No surface features were noted in the rock shelter. Only two artifacts were observed at the site. These included two pottery fragments that are possibly attributable to the Fremont. During site visits in 2001 and early 2002, the interior of the rock shelter appeared to have sustained rodent damage and/or looting.

3b) Current condition

3b.1) Illegal excavation: (check) present X absent

Describe The site was visited in 2001 to take measurements and determine if any adverse affects have occurred. No changes were noted from the original 2000 baseline data.

3b.2) : Graffiti (check) present absent X

Describe None

3b.3) : Unintentional damage:

b.3.1) Footprints (check) present X absent

b.3.2) Trail/footpath (check) present absent

b.3.3) Camping on or near (check) present absent X

Describe None

b.3.4) Recent trash (check) present_____ absent X
Describe None

3b.4) Animal damage:
b.4.1) Livestock trails (check) present_____ absent X
Describe None

b.4.2) Livestock wallows (check) present_____ absent X
Describe None

b.4.3) Rodent burrowing (check) present X absent_____
Describe There is minimal, if any, rodent activity, on the interior surface of the rock shelter. The south end of the rock shelter has a possible animal dug-out area, such as might be made by a large rodent or other small mammal.

3.b.5)Natural Damage
b.5.1) Water erosion (check) present X absent_____
Describe Sedimentary deposits within the rock shelter are intact, except along the drip line where water has exposed the bedrock. The natural water runoff route is over the top of the rock shelter and down into the drainage. The drainage spillway is aligned with the now damaged portion of the rock shelter. The potential for further damage to the interior of the rock shelter is likely to occur through water erosion. Monitoring in 2003 suggests that minimal damage by water erosion has occurred, likely due to the additional rock that has fallen in the rock shelter.

b.5.2) Geologic structure
A) Block failures:
Describe Damage report from 2002 - Mining activity near site 42SV2433 appears to have caused damage to the rock shelter. While some natural spalling of rock was evident at the site prior to mining activities in the area, the majority of rock now covering the front interior surface of the rock shelter appears to be a direct result of subsidence. Several large rock fragments cover the front interior surface of the rock shelter. This rock exhibits evidence that it separated from the bedrock roof of the rock shelter in a single 25 foot long section that broke apart when it landed on the rock shelter interior surface. The rock rubble forms a four feet high stone wall across the front of the rock shelter. Conversely, only a thin layer of sandstone has fallen at the back of the rock shelter, leaving the central interior of the rock shelter void of rock. Two one-inch wide, east-west oriented cracks are located , 1) in the ground surface above the rock shelter, and 2) along the top of the rock shelter in the drainage channel. Both cracks appear to be of recent origin. The rock fragments across the front interior of the rock shelter and the two surface cracks were not

evident in the original documentation of the site, supporting the contention that they are a result of subsidence.

Damage report from 2003 - Mining activity near the site appears to have caused additional rock fall across a ten foot wide area in the rock shelter interior, particularly at the middle interior. Most of the interior floor of the rock shelter is no longer visible. The very back recesses of the rock shelter floor may be accessible however, the roof of the structure is now thinner with minimal stability. The large east-west oriented crack on the north side of the rock shelter has expanded in width since 2002. The front interior area of the rock shelter does not appear to have sustained additional damage from water erosion.

Damage report from 2004 - Inspection of the rock shelter indicated that its condition primarily remains the same as noted in 2003. The central portion of the rock shelter may have some minor additional ceiling spalling. The roof area was initially fractured, enabling thin slab pieces to be spalled from the ceiling and pile onto the thick debris accumulated on the floor. Overall, the main roof fall block debris appears to be the same. The main cracks along the top of the shelter in the bedrock appear to be the same in size. Water erosion still appears to be minimal, as the fallen roof debris protects the overall floor area of the shelter below the drainage channel. No other movement or damage was apparent at the site.

B) Surface cracking:
Describe The crack along the top of the rock shelter in the drainage channel appears to be the same 2003.
C) Slumping:
Describe None

D) Slide deposits:
Describe None

4. Assessment of Effects
4a) NRHP: This site was initially deemed unevaluated, by AERC in 1997, pending further testing and data on the subsurface soil deposits. This site was impacted by subsidence activity in the spring of 2002.

4b)Natural/Human effects (see section 3): Water erosion, animal burrowing, and vandalism are the primary impacts to the interior of the rock shelter. Overall, the fill of the rock shelter is in moderate condition. Any cultural deposition likely remains intact because of the now collapsed condition of the rock shelter.

5) Movement- Datum nail points: Total station setup: None/Collapsed _____cm_(height)
---All METRIC---- (Top of datum to tripod plane)
Datum point #1: Vertical _____ Horizontal:_____
Vert. Dist._____ Horz.Dist. _____
Datum point #2: Vertical _____ Horizontal: _____

Vert. Dist._____ Horz.Dist. _____

Datum point #3: Vertical _____ Horizontal:_____

Vert. Dist. _____ Horz.Dist. _____

Datum point #4: Vertical _____ Horizontal: _____

Vert. Dist._____ Horz.Dist._____

SUFCO: Vertical _____ Horizontal:_____

Vert. Dist._____ Horz.Dist. ___

Photography: (see site map) SUFco Monitoring Roll# June Date 2004

Site # 42SV2433

Shot# 47 Point Photo #1 : Angle view 35 mm Degree Dir. _____

Descr. _____

Shot# ____ Point Photo #2 : Angle view 35 mm Degree Dir. _____

Descr. _____

Shot# 53 Point Photo #3 : Angle view 35 mm Degree Dir. _____

Descr. _____

Shot# 50 Point Photo #4 : Angle view 35 mm Degree Dir._____

Descr. _____

Shots # 44-46,48

Descr. General views of the site _____

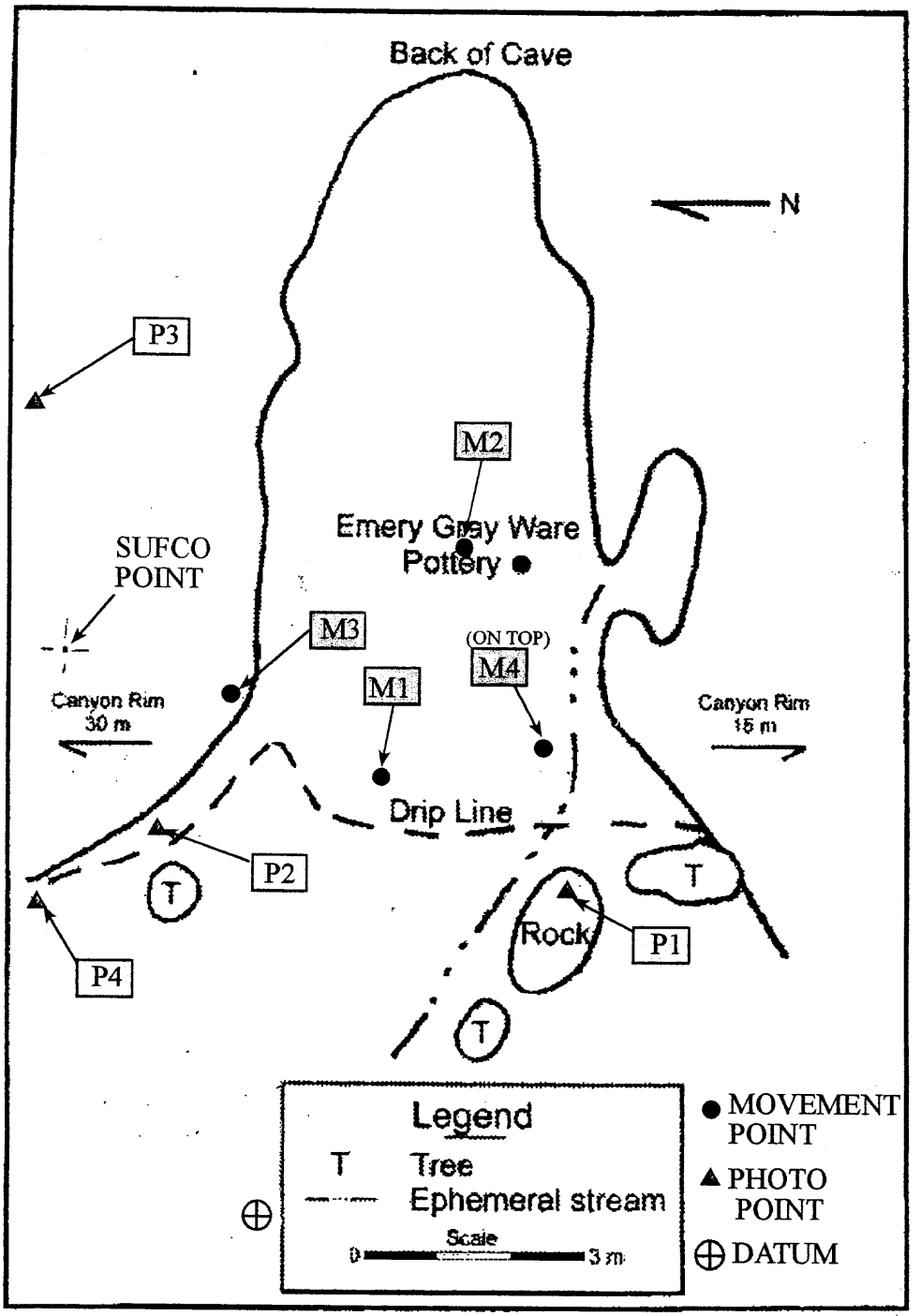


FIGURE 1: Site sketch of 42SV 2433
Big Mac Rock Shelter

42SV2433

SUFCO SITE MONITORING FORM

--Pines Tract--

1)Site No.: 42SV2434 (Little Mac)

Field Date: June 2004

Schedule: B

2) Anticipated effects from subsidence

a) General Effects as in EIS: Longwall coal mining causes a number of geological stresses on the landscape during and after mining is completed. The stress factors of subsidence consisting of compression and tension, can lead to tension cracks and escarpment failure in the canyons and rock outcrops. Based on the data compiled by Agapito and Associates for the project, four levels of impact have been identified that relate to the degree of subsidence at a given location.

b) Specific Anticipated Effects during and after: This site has been placed into Level III. Level III addresses cultural resource sites that are located on cliff edges, overhangs, or canyon edges. At Level III, subsidence and compression are present with compressional strains possibly causing some buckling and/or movement of the rock. At this level of impact, it is recommended that the mining takes place.

3) Condition Assessment

3a) Baseline condition: This site, named Little Mac, was originally recorded by AERC in 1997. The site is a moderate size rock shelter situated just east of site 42SV2433, near the head of a side drainage in Box Canyon. The rock shelter is nine meters by five meters in size, with a low ceiling of between one and one and one half meters in height. No surface features were noted in the rock shelter. Two ground stone fragments and a biface were found within the rock shelter in 1997. Cultural deposits as described by AERC were intact, except along the drip line where water exposed the bedrock.

3b) Current condition

3b.1) Illegal excavation: (check) present X absent

Describe Originally, possible digging evidence was noted near the rock shelter entrance. It is a small depression, round in shape, about 44 cm by 50 cm in size. It is possible that this depression was created by an animal.

3b.2) : Graffiti (check) present absent X

Describe None

3b.3) : Unintentional damage:

b.3.1) Footprints (check) present absent X

b.3.2) Trail/footpath (check) present X absent

b.3.3) Camping on or near (check) present_____ absent __X___
Describe __A Forest Service road is located about 75 feet from the rock shelter. A cow trail on top of the shelter is about three to four feet from the rock overhang. The trail is oriented in a northeast to southwest direction.

b.3.4) Recent trash (check) present ___X_____absent_____
Describe __Broken glass was noted near the top edge of a drainage about 25 meters from the rock shelter.

3b.4) Animal damage:
b.4.1) Livestock trails (check) present ___X_____ absent_____
Describe __Cow manure and a livestock trail were noted about 10 meters in front of the shelter, within the bottom of the drainage. There is also a cow trail running above the shelter.

b.4.2) Livestock wallows (check) present_____ absent ___X____
Describe __None

b.4.3) Rodent burrowing (check) present ___X____ absent_____
Describe ____Originally, wood and other debris has been introduced by possible rodents. Stone roof blocks have fallen to the interior of the rock shelter.

3.b.5)Natural Damage
b.5.1) Water erosion (check) present ___X_____ absent_____
Describe Originally, minimal erosion occurred at the site, primarily in the form of moisture seepage. With the recent collapse of the overhang, the interior of the rock shelter is now increasingly vulnerable to water runoff. In 2003 there was no visible water channeling in front of the shelter. Because more of the front roof edge has broken off this year, water is flowing directly onto the interior floor of the rock shelter and pooling. There is minimal to no evidence of water outflow from the rock shelter.

b.5.2) Geologic structure
A) Block failures:
Describe Damage report from 2002 - Subsidence in the vicinity of site 42SV2434 appears to have resulted in damage to the rock shelter. Although some natural spalling of rock was evident at the site prior to mining activities in the area, the majority of the rock now covering the interior surface of the rock shelter appears to be a direct result of subsidence. Two large fragments of rock, one measuring 15 feet by 15 feet and one approximately six feet in length, cover the interior surface of the rock shelter. These fragments exhibit evidence that they have recently fallen from locations associated with the bedrock that formed the roof of the rock shelter. A one-inch wide, east-west oriented crack located in the ground surface above the rock shelter also appears to be of recent origin. The two rock fragments and the surface

crack were not evident in the original documentation of the site, supporting the contention that they are a result of subsidence.

Damage report from 2003 - Mining activity near the site appears to have caused additional rock spalling from the southern edge of the rock shelter. More smaller rocks have eroded off the roof edge and fallen into the interior of the rock shelter. There is evidence of considerable water damage from the drainage inflow to the rock shelter due to run-off and thunderstorms. Water has apparently dropped into the rock shelter with minimal to no outflow area visible. The rock fall within the interior and at the front of the rock shelter appears to prevent the water from efficiently exiting, thus the water is pooling in the interior. There is no visible water channeling in front of the shelter.

Damage report from 2004 - Inspection of the rock shelter indicated that its condition primarily remains the same as that from 2003. Some soil erosion appears to be present along the top edge, above the rock shelter, at its break line. The interior rear portion of the rock shelter is still standing. While no pooled sediments from water erosion were observed within the interior or on the outside of the rock shelter, the floor of the rock shelter is susceptible to heavy water runoffs. Silty and sandy soils, along with small broken rock cover the interior and rear half of the rock shelter

B) Surface cracking:

Describe From 2002, a one-inch wide, east-west oriented crack located in the ground surface above the rock shelter appears to be of recent origin.

C) Slumping:

Describe None

D) Slide deposits:

Describe None

4. Assessment of Effects

4a) NRHP: During site visits in 2001 and early 2002, the interior of the rock shelter appeared to have sustained minimal rodent activity and/or looting. This site was initially deemed unevaluated, by AERC in 1997, pending further testing and data on the subsurface soil deposits. This site was impacted by subsidence activity in the spring of 2002 and additionally in 2003.

4b)Natural/Human effects (see section 3): Some possible looting was noted during the initial baseline data collection, but the human effects appeared to be minimal. Following mining subsidence in 2002 stone blocks have fallen from the roof of the rock shelter onto the interior floor surface.

5) Movement- Datum nail points: Total station setup: None/Collapsed (height)

---All METRIC---- (Top of datum to tripod plane)

Datum point #1: Vertical _____ Horizontal: _____

Vert. Dist. _____ Horz.Dist. _____

Datum point #2: Vertical _____ Horizontal: _____

Vert. Dist. _____ Horz.Dist. _____

SUFCO Point : Vertical _____ Horizontal: _____

Vert. Dist. _____ Horz.Dist. _____

Photography: (see site map) SUFco Monitoring Roll# June Date: June 2004

Site # 42SV2434

Shot# 38 Point Photo #1 : Angle view 35 mm Degree Dir. _____

Descr. _____

Shot# 37 Point Photo #2 : Angle view 35 mm Degree Dir. _____

Descr. _____

Shot# 39 Point Photo #3 : Angle view 35 mm Degree Dir. _____

Descr. _____

Shot# 41 Point Photo #4 : Angle view 35 mm Degree Dir. _____

Descr. _____

Shot# 33-36,40 : Angle view 35 mm Degree Dir. _____

Descr. General shots of the site area

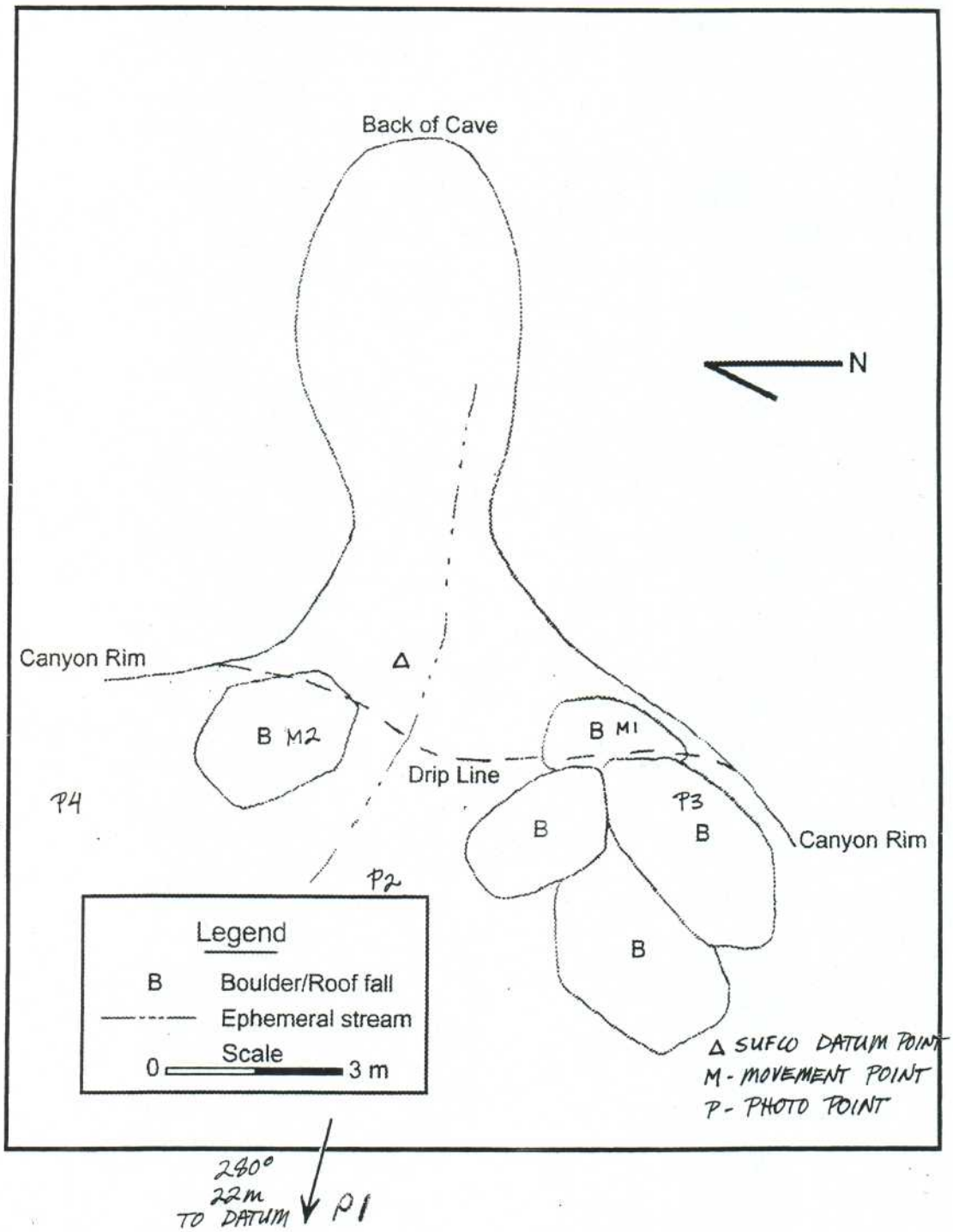


FIGURE 1: Site sketch of 42SV 2434
Little Mac Rock Shelter

42SV2434

APPENDIX C

Legal Financial, Compliance and Related Information

Annual Report of Officers
As submitted to the Utah Department of Commerce

Other change in ownership and control information
As required under R645-301-110

CONTENTS

Submitted in Canyon Fuel Company, LLC General Chapter One

APPENDIX D

Mine Maps

As required under R645-302-525-270

CONTENTS

Mining Progress Map 2004

APPENDIX E

Other Information

In accordance with the requirements of R645-301 and R645-302

CONTENTS

None