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Canyon Fuel
Company, LLC.
Sufco Mine

A Subsidiary of Arch Western Bituminous Group, LLC.

Ken May, General Manager
397 South 800 West
Salina, UT 84654
(435) 286-4400 - Office
(435) 286-4499 - Fax

March 21, 2007

Utah Coal Regulatory Program
1594 West North Temple, Suite 1210
P. O. Box 145801
Salt Lake City, UT 84114-5801

Davis
C/041/0002

Re: 2006 Annual Report for Canyon Fuel Company LLC, SUFCO Mine
C/041/002, Sevier County, Utah

Dear Permit Supervisor:

Enclosed herewith is a copy of the annual report for the Canyon Fuel Company, SUFCO Mine for 2006. The information included is thought to be complete as requested. Questions should be referred to Mike Davis at (435) 286-4421.

Sincerely,
CANYON FUEL COMPANY, LLC
SUFCO Mine

Kenneth E. May
Kenneth E. May
General Manager

Enclosures

KEM/MLD:kb

cc: Division of Oil, Gas and Mining – Price Field Office
Division of Oil, Gas and Mining Correspondence File

File in:
C/041/002, 2007, Incoming
Refer to:
 Confidential
 Shelf
 Expandable
Date *3/21/07* For additional information

RECEIVED

MAR 28 2007

DIV. OF OIL, GAS & MINING

2006 ANNUAL REPORT



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

File in:

Confidential

Shelf

Expandable

Refer to Record No 0028 Date 3/21/07
In C1041/002, 2003, Incoming
For additional information

GAE 1-08

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 than permittee)	
Permit Expiration Date	05/20/2007
Permit Number	C/041/002
Authorized Representative Title	Kenneth E. May, General 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, 2011
	UTR000576	Multi-Sector Storm Water Permit	December 31, 2011
PSD Permit(s) (Air)	DAQE-AN0665008-06	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 under the approved plan that must be periodically submitted to 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	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Refuse Piles	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Certified Reports prev. submitted
Impoundments	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Certified Reports prev. submitted
Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

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	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Included on disk in Appendix B
Subsidence Monitoring	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Included in Appendix B
Vegetation Monitoring	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Included in Appendix B
Raptor Survey	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Included in Annual Report 2006 Confidential Folder
Soils Monitoring	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Included in Appendix B
Water Monitoring	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
First quarter	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Second quarter	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Data previously submitted
Third quarter	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Data previously submitted
Fourth quarter	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Data previously submitted
Geological / Geophysical	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Engineering	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Non Coal Waste / Abandoned Underground Equipment*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Other Data					
East Fork of Box Canyon Monitoring	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Included in Appendix B
Macroinvertebrate Study of East Fork	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Macroinvertebrate Study will be submitted when Consultant completes it.
2006 Cultural Resource	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Included in Annual Report 2006 Confidential Folder
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

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

Climatological Data on Disk
Subsidence Report
Vegetation Monitoring-Pines Tract
Vegetation Monitoring - Link Canyon Portals
Soils Monitoring - Waste Rock Disposal Site
East Fork of Box Canyon Studies-Biomonitoring
East Fork of Box Canyon Studies-Macroinvertebrate
East Fork of Box Canyon Studies-Hydrology

2006 SUBSIDENCE REPORT

CANYON FUEL COMPANY, LLC

SUFCO MINE

by

Keith B. Bigelow P.L.S.

INTRODUCTION

Canyon Fuel Company LLC, SUFCO Mine's 2006 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. Lease ML 49443-OBA was flown in 2006.

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 12.5 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.

2006 SUBSIDENCE

The 2005 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 is 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 has been mined out for four years, and monitoring suggests that it has settled. It is now assumed to be dormant.

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 has shown no significant movement in the last few years so will be considered dormant.

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 and will continue until February 2007. This area is active and being monitored.

AREA 13

Area thirteen is a longwall mining block consisting of seven panels on lease U-63214 and lease ML 49443-OBA. An elevation baseline for the area included on lease U-63214 was established in 1991 and the elevation baseline for the area included on lease ML 49443-OBA was established in 2006. Longwall mining is scheduled to begin in March 2007 and continue until 2010. This area will be considered active in 2007 and will continue to be monitored for several years.

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.

Longwall mining at the top of the 13L4E longwall panel caused some cracking in the escarpment sandstone of upper Box Canyon. The panel was mined parallel and down the center of a portion of the canyon. Subsidence thus created an inward pull on the canyon walls. These cracks are in the rock along the edge of the escarpment and vary in width and displacement. A monitoring program was initiated in 2004 to observe the behavior of these cracks. A chart of this data is included at the end of this report. These cracks will be checked again in 2007 and an updated chart will be included in the 2007 subsidence report.

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, 10, 11 are all considered to be dormant. Photographic coverage can be obtained if circumstances deem it necessary. There is active longwall mining in Area 12 until February of 2007 causing subsidence. Yearly monitoring of Area 12 will continue until it has been determined that subsidence has ceased. The baseline elevations for the new longwall panels on lease ML 49443-OBA in Area 13 were established in 2006. Longwall mining in this area will begin in March 2007. Subsidence monitoring in this area will start in 2007 and will continue for several years. The monitoring of the subsidence cracks in the escarpment along upper Box Canyon will continue.

KBB:kb

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BOX CANYON ESCARPMENT CRACKS

CRACK STATION SUFCO	WIDTH OF CRACKS	DROP OF CRACKS	X	Y	Z
BCE Crack 01 Sta 01			120843.93	131055.41	8369.66
AUGUST 2004	1.0'	0.50'			
SEPTEMBER 2005	1.05'	0.30'			
BCE Crack 01 Sta 02			120864.47	130972.33	8369.48
AUGUST 2004	1.7'	0.48'			
SEPTEMBER 2005	1.9'	0.50'			
BCE Crack 01 Sta 03			120903.89	130796.70	8370.63
AUGUST 2004	0.47'	0.35'			
SEPTEMBER 2005	0.47'	0.37'			
BCE Crack 02 Sta 01			121016.97	130673.02	8376.34
AUGUST 2004	0.08'	0.0'			
SEPTEMBER 2005	0.07'	0.0'			
BCE Crack 02 Sta 02			121024.30	130591.32	8373.91
AUGUST 2004	0.09'	0.0'			
SEPTEMBER 2005	0.07'	0.0'			
BCE Crack 03 Sta 01			120931.85	130817.12	8371.88
AUGUST 2004	0.33'	0.0'			
SEPTEMBER 2005	0.32'	0.0'			
BCE Crack 03 Sta 02			120940.62	130713.78	8373.38
AUGUST 2004	1.17'	0.01'			
SEPTEMBER 2005	1.15'	0.03'			
BCE Crack 03 Sta 03			120941.99	130593.20	8370.72
AUGUST 2004					
SEPTEMBER 2005	0.5'	0.3'			
BCE Crack 04 Sta 01			120291.04	131471.84	8366.01
AUGUST 2004	0.08'	0.03'			
SEPTEMBER 2005	0.08'	0.03'			
BCE Crack 04 Sta 02			120110.25	1311468.03	8358.60
AUGUST 2004	0.04'	0.0'			
SEPTEMBER 2005	0.04'	0.0'			

PINES TRACT VEGETATION STUDY

Prepared by
Keith W. Zobell, Environmental Specialist
July 31, 2006

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

On July 18, 2006 The Pines Tract Area was visited by Keith W. Zobell (Environmental Specialist) and Mike Davis (Mining Engineer for Canyon Fuel Company, SUFCO Mine). The purpose of this trip was to revisit all of the original photographic points that have been established and to retake photographs at each of the sites and to determine the general vegetation growth, plant vigor and plant condition at each of the established photographic sites. These sites are revisited each year at approximately the same date so as to reduce any possible seasonal variations. Photographs of each site are identified and included at the end of this report.

The weather records at the SUFCO Mine site showed that approximately 75% of the normal moisture had been received through the end of June 2006, for this moisture year. This below normal moisture has had some influence on the overall growth and vigor of the vegetation of the area. The overall growth is still fairly good and definitely better than what was observed during the drought years. The stream in Box Canyon continues to basically dry above monitoring station 090. The stream flow starts just below station 090. There are some small intermittent flows above station 090 up to Pines monitoring station 219, with the creek being totally dry above this station. The small pond at the "Grotto" area continues to be dry, however there is dripping water on the cliff faces just above the pond area. The spring at monitoring station Pines 105 and photographic point 10 is dry. This area was under-mined in late December 2005 and early January 2006. When the site was visited by Mine personal in the early spring of 2006 it was discovered that the spring had stopped flowing. This was reported to the regulatory agencies. Since this spring has stopped flowing it has had some affect of the vegetation in the immediate area. The Pines Tract grazing unit was grazed this spring, which has had an affect of the plant growth and vigor within the tract.

At photographic point 1a there is still one columbine plant with several inflorescences stems ranging from 18 to 24 inches in length. This plant has good vigor and is growing out of a rock fracture and is probably getting moisture from the fracture.

At photographic point 1b there are two columbine plants in bloom. The inflorescence is 24+ inches in length. These plants have good vigor and are also growing out of a rock fracture and are probably getting moisture from this fracture.

At photographic point 1c the columbine plant is located approximately 15-20 up on the cliff face so exact measurements cannot be made. It appears that there is still only one plant at this site. The columbine plant is in bloom with several seed stocks and the inflorescence appears to be approximately 18 inches in length. The plant appears to have good vigor.

At photographic point 2 the columbine plants are located approximately 20-25 feet up on the cliff face so exact measurements cannot be made. There appears to be three living plants and one dead plant at this site. The living plants have good vigor and good inflorescence which are approximately 18 inches in length.

At photographic point 3 there are still two columbine plants. One plant has good vigor with inflorescence of 18 inches in length. The second plant is small with only fair vigor and had no inflorescence. This is a dry site.

At photographic point 4 there are several columbine plants with 10-14 inches of inflorescence. The *Carex* species have a basal growth of 4-5 inches with no seed heads. Woods rose has new twig growth of 4-5 inches. Aspen has new twig growth of 9-12 inches. The one *Potentilla* plant has new growth of 2-3 inches. This is a dry site which results in a low density of plants. The site has not been grazed. The overall vigor of this site would be considered good.

At photographic point 5 there are still three columbine plants. The site has been heavily grazed. Bluegrass has no seed heads and has 3-4 inches of leaf regrowth. Hairgrass has no seed heads and has 6-7 inches of regrowth. *Carex* has no seed heads and has 4-5 inches of regrowth. Yarrow has no seed heads and has 2-3 inches of basal leaf growth. There is no water in the creek bed. All three of the columbine plants have been grazed. One columbine plant is small with no inflorescence and has low vigor, one columbine plant has low vigor with a 9 inch inflorescence, and one plant has fair vigor with a 12 inch inflorescence.

At photographic point 6 the site has been heavily grazed. This is a dry meadow site with a wet riparian site along the creek bed. There is no water in the creek bed. At the dry meadow site all of the new twig growth on the Aspen has been grazed off. Woods Rose has been grazed but still has a few 2-3 inch long twigs of new growth. There are a few scattered Yarrow plants with 9 inch inflorescence. The Bluegrass has no seed heads and has 3-4 inches of regrowth. The herbaceous sage has been heavily grazed and has no seed heads and little if any regrowth. *Carex* has no seed heads with 2-3 inches of

regrowth. *Juncus* is almost non-existent. Ocular estimates show the site to have 35-40% bare ground. The overall vigor at this site would be low fair to poor. At the wet riparian site the *Carex* has been heavily grazed but has shown good regrowth of 5-7 inches and has fair to good vigor.

At photographic point 7 there are still no columbine plants. The site has been heavily grazed and there is no water in the creek bed. The *Geranium* plant has no seed head and has only 2-3 inches of basal growth. The Yarrow plants have no seed heads and have 2-3 inches of basal growth. The *Carex* plants have 3-4 inches of regrowth. There are no Horsetail plants showing. Ocular estimates show this site to have 75% bare ground.

At photographic point 8 there is moisture coming from the fractures in the cliff face. The ferns appear to be increasing in density and have a vegetative growth of 5-10 inches in length. There appear to be many new small fern and lichen plants. There are no dead fern plants.

At photographic point 9a there is moisture coming from the fractures in the cliff face. The ledge at this site is almost completely covered with lichens. The ferns have a good growth of 4 inches. There are no dead fern plants.

At photographic point 9b there is moisture coming from the fractures in the cliff face. There is good lichen growth and an increase in density of the ferns. The ferns have a vegetative growth of 4-7 inches.

At photographic point 10 the site is originally a dry meadow site. It has been heavily grazed. All the new twig growth of the Aspen has been grazed off. Woods Rose has no flowers and all of the new growth grazed off. Sagebrush has not been grazed and has 4-5 inches of new growth. There are a few scattered *Juncus* plants that are 4-6 inches in height with no seed heads. All grass species have been grazed to ground level and show no regrowth. Ocular estimates show the site to have 50-60% bare ground. The adjacent moist riparian area has been heavily grazed but has good regrowth of the *Carex* plants, which have a 8-10 inches of regrowth. The soil in this area is dry and if the Spring 105 continues to not flow, it will have effects on this riparian area.



Photo Point 1a



Photo Point 1b



Photo Point 1c

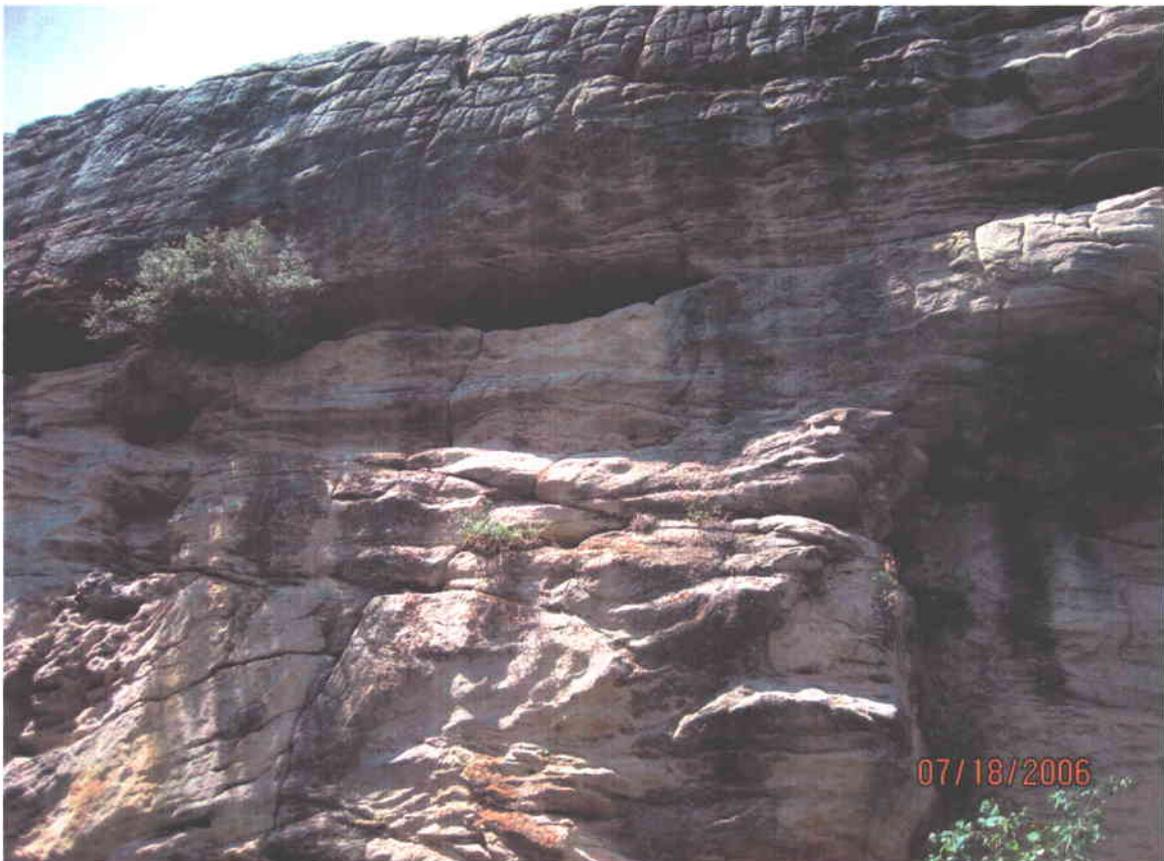


Photo Point 2



Photo Point 3

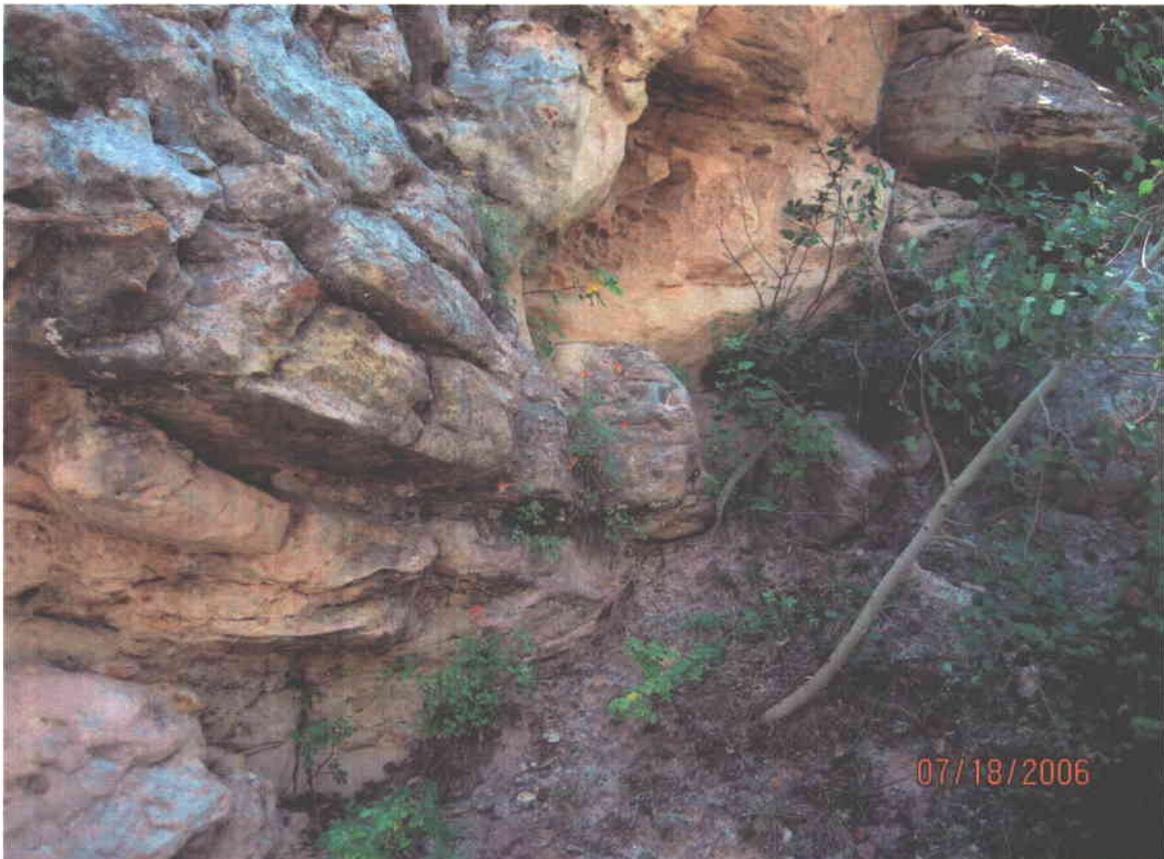


Photo Point 4



Photo Point 5



Photo Point 6



Photo Point 7



Photo Point 8

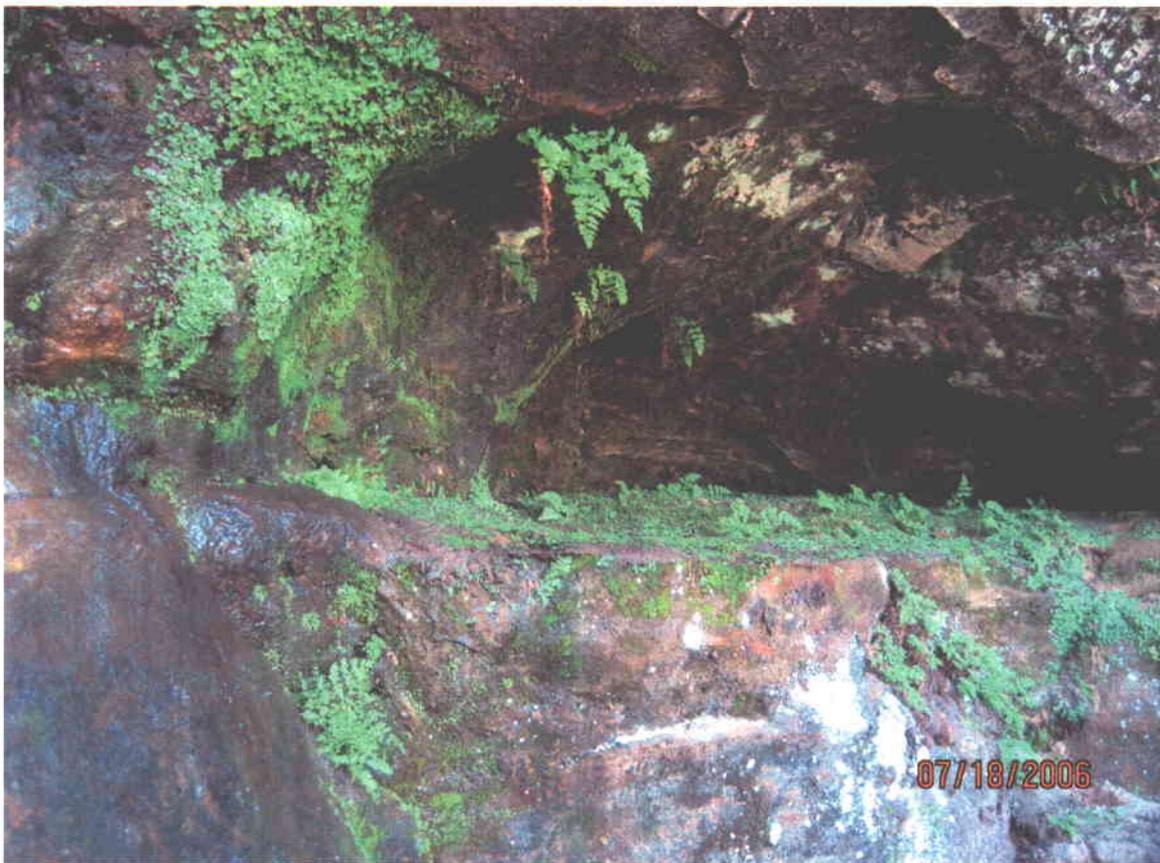


Photo Point 9a



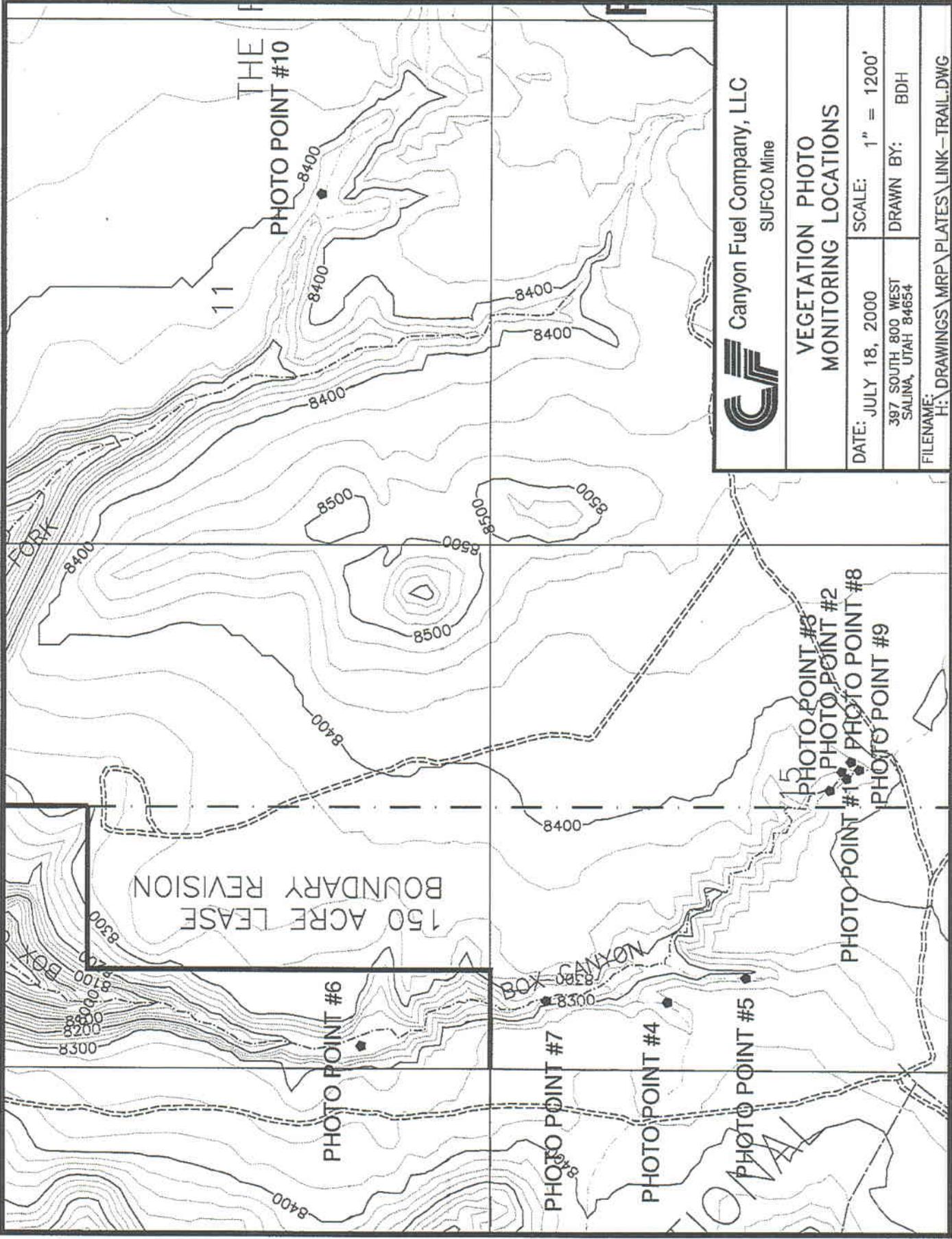
Photo Point 9b



Photo Point 10



Photo Point 10-wet meadow



CFC 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	

LINK CANYON MINE PORTAL VEGETATIVE STUDY

Prepared by
Keith W Zobell, Environmental Specialist
June 24, 2006

Photographs were retaken at the Link Canyon Mine portal area on June 23, 2006. The area has not received any significant rainfall since mid May. Overall the ground cover density of plants is lower than last year, and the growth is not as good as last year. This may be due to the difference in rainfall between the two years.



Link Canyon West Portal photo Point

There is no water discharge from this portal and no evidence that there has been any. The Willow (*salix spp.*) is in the late bloom stage. There are insect galls on many of the seed heads. The current new growth is 2-4 inches. There doesn't appear to be any new dead Willow plants. Wood Rose (*Rosa woodsii*) has bloomed and has set seed. It has 4-6 inches of new growth. Bluegrass (*Poa pratensis*) density is down considerable from last

year. The plants that are there only are in the 3-4 leaf stage and have very few seed heads. The density of wiregrass (*Juncus balticus*) is approximately half of that of last year. The height of the wiregrass is 10-12 inches with some seed heads. Clematis (*Clematis ligusticifolia*) has good growth and good vigor. The squawbush (*Rhus aromatica* var. *trilobata*) has bloomed and set seed and has 6-8 inches of new twig growth.

The overall growth and vigor at this portal area is not as good as last year. This is probably due to a combination of factors—1) The continued airflow from the mine discharge fan, 2) The difference in rainfall between the two years and 3) no moisture being discharged from the portals.



Link Canyon East Portal Photo Point

There has been no discharge from this portal and the area is dry. The density of the plants is significantly lower than last year. The Dogwood bush (*Cornus stolonifera*) has some additional die back from last year. It has bloomed and set seed. It has 1-2 inches of new twig growth. Land the vigor is considered fair. The Clematis growth is good with good vigor. The gooseberry plant has new growth of 4-6 inches. The density of the wiregrass is about 50% of last year with an average height of 1-12 inches with very few seed heads. The vigor of the wire grass would be considered poor. There are very few bluegrass

plants and they have no seed heads. The Willow plants have bloomed. There are no insect galls on the seed heads at this site. The willow has a new growth of 2-3 inches.

LINK CANYON MINE PORTAL VEGETATIVE STUDY

Prepared by
Keith W. Zobell, Environmental Specialist
October 16, 2006

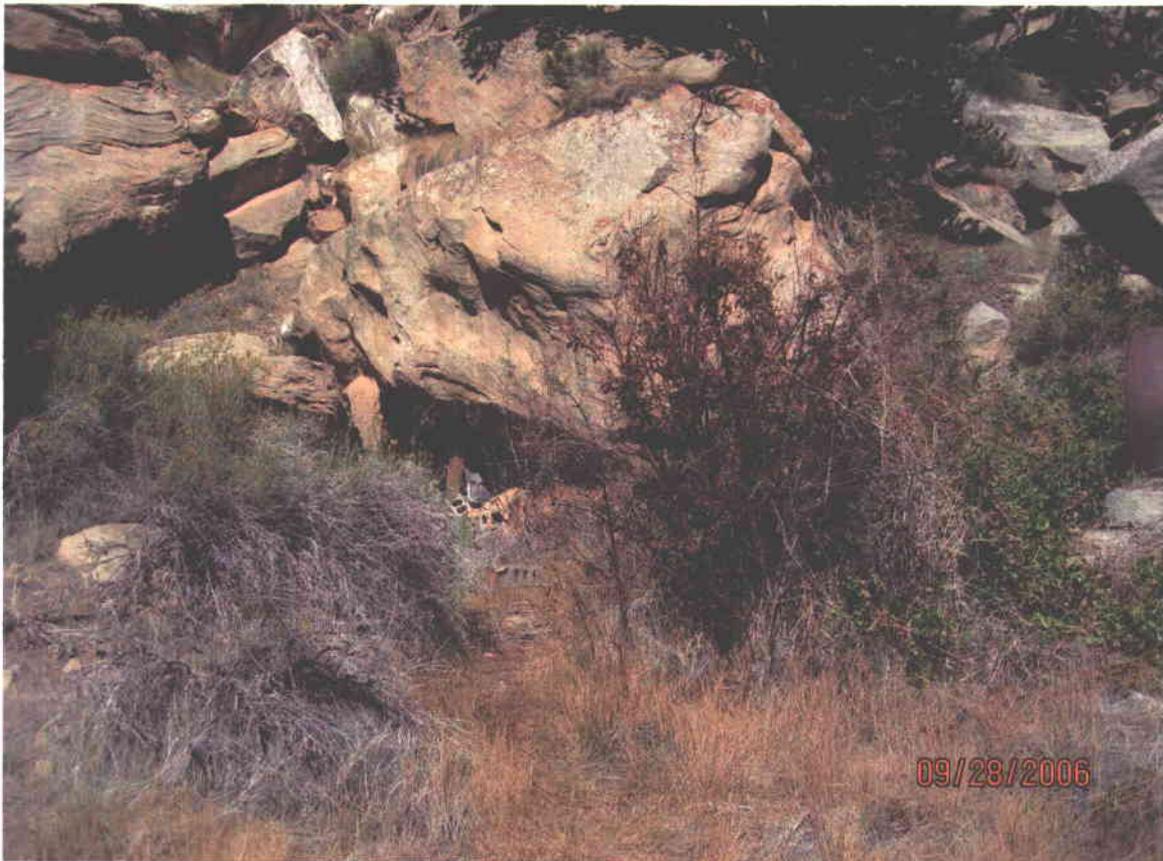
Photographs were retaken at the Link Canyon Mine portal area on September 28, 2006. The area has received only sporadic thunderstorm moisture this summer. Overall the density and vigor of most of the vegetation seems to be on a downward trend.



Link Canyon West Portal photo point

There is no water discharge from the West portal and there is no evidence that there has been any. The Willow (*Salix spp.*) has a current new growth

of 6-10 inches. There is no evidence of the insect galls that were present earlier this spring. It does appear that there is some additional new dead wood on some of the plants. Woods Rose (*Rosa woodsii.*) has some viable seed with a current growth of 4-6 inches. The amount viable seed is not as much as what you would expect to see. The Bluegrass (*Poa pratensis*) has poor density with 4-6 inches of leaf growth with very few seed heads. The density of wire grass (*Juncus balticus*) seems to be a little better than what it was in June, but still is only fair. The wiregrass has a current growth of 12-14 inches with very few seed heads. The Clematis (*Clematis ligusticifolia*) has good growth with fair seed production. The squawbush (*Rhus aromatica var. trilobata*) has good growth of 6-8 inches of current growth. There are no seeds left on the plant. The site continues to be very dry and the overall condition of this site appears to be in a downward trend.



Link Canyon East Portal Photo Point

There is no water discharge from the East portal and the site continues to be very dry. The density of the vegetation continues to be only fair and appears to be declining. The Dogwood Bush (*Cornus stolonifera*) has some additional die back. There is no current terminal bud growth and all of the current growth of 3-4 inches is from lateral buds. There is no seed on the plant. The vigor of this plant is poor. The Clematis (*Clematis ligusticifolia*) has good growth but has very few seed heads. The Gooseberry (*Ribes spp.*) has a current years growth of 12-14 inches but there is no seed present on the plant. The wiregrass (*Juncus balticus*) has current growth of 14-16 inches with very few seed heads. The density is only fair. The Bluegrass (*Poa pratensis*) has a current growth of 4-6 inches with very few seed heads. The Willow (*Salix spp.*) has 7-10 of new growth. There is some additional dead wood on the willow plants. The Rabbitbrush (*Chrysothamnus nauseosus*) has 8-10 inches of new growth. There is some dead wood at the base of the plants. The Rabbitbrush plants are all in bloom. Overall this site appears to be in a downward trend.

LINK CANYON MINE PORTAL VEGETATIVE STUDY

Prepared by
Keith W. Zobell, Environmental Specialist
November 13, 2006

The Link Canyon Portal area has had no new growth since the last photographs were taken in September 2006. This is due to end of the growing season and freezing nights that have been occurring for the past several weeks. The area has received some moisture from several storms in the past few weeks.



West Portal Area

The majority of the leaves have fallen although there are a few still persisting on some plants. No significant vegetative changes have taken place since the last pictures were taken in September 2006.



East Portal Area

Leaf fall is complete except for the Rabbitbrush and Sagebrush plants. There have been no significant vegetative changes since the last photographs were taken in September 2006.

Waste Rock Disposal Site Material Analyses

Year	Quarter	Lab	Lab ID	EC				Total				Neutral.		T.S.		Alkalinity	
				pH	Saturation %	@ 25° C dS/m	Calcium meq/L	Magnesium meq/L	Sodium meq/L	SAR	Sulfur %	AB	ABP	Pot.	ABP	Boron ppm	Selenium ppm
2000	1	Int	0100S20484	7.0	49.6	3.96	23.50	14.70	8.69	1.99	0.32	10.00	78.2	68.2	7.73	0.02	1.57
2000	2	Int	0100S20485	7.2	47.5	1.02	2.65	3.19	4.11	2.41	0.38	11.90	52.9	41	5.37	0.02	2.82
2000	3	Int	0100S20486	6.9	55.5	3.82	21.10	8.81	11.50	2.98	0.41	12.80	52.4	39.6	4.95	0.02	2.16
2000	4	Int	0100S20487	7.2	47.8	1.36	3.06	3.61	6.38	3.49	0.43	13.40	50.4	36.9	4.43	0.02	3.38
2001	1	Int	0101S09020	7.3	45.1	4.50	28.10	15.70	14.20	3.03	0.54	16.90	92.1	75.2	6.84	< 0.02	1.44
2001	2	Int	0101S11636	7.3	50.9	3.78	14.50	13.40	15.40	4.12	0.48	15.00	39.3	24.3	8.45	< 0.02	2.33
2001	3	Int	0101S19152	7.0	40.2	9.19	39.20	27.10	35.30	6.14	0.44	13.70	89.8	76.1	5.28	< 0.02	2.11
2001	4	Int	0101S23729	6.8	52.2	4.35	28.60	12.80	10.70	2.35	0.50	15.60	56.2	40.6	6.54	0.02	2.08
2002	1	Int	0102S06276	6.9	39.7	12.40	43.70	32.10	60.80	9.87	0.43	13.40	91.2	77.8	5.28	< 0.02	2.31
2002	2	Int	0102S12107	7.2	43.6	8.64	38.90	22.90	38.10	6.85	0.45	14.10	83.5	69.5	5.53	< 0.02	2.83
2002	3	Int	0102S19293	7.4	46.8	4.27	26.00	22.00	8.61	1.76	0.79	24.70	56.6	32.0	7.61	0.04	1.81
2002	4	Int	0102S24366	7.0	35.2	8.22	34.90	36.90	23.00	3.84	0.62	19.40	104.0	84.2	5.26	0.02	2.25
2003	1	Int	0103S02028	7.4	51.5	4.80	15.40	8.75	21.30	6.12	0.41	12.80	50.2	37.4	2.66	< 0.02	1.79
2003	2	Int	0103S07189	7.1	39.6	12.80	36.70	31.40	80.00	13.70	0.59	18.40	108.0	89.9	7.39	0.02	1.06
2003	3	Int	0103S14524	7.2	53.3	2.43	14.60	7.84	8.45	2.53	0.57	17.80	44.2	26.4	6.03	< 0.02	1.94
2003	4	Int	0103S19355	7.4	51.9	9.42	16.60	10.10	63.10	17.30	0.51	15.90	48.0	32.1	7.55	< 0.02	2.95
2004	1	Int	0104S03718a	7.4	60.5	4.14	5.08	2.22	27.10	14.20	0.37	11.60	26.9	15.4	4.08	< 0.02	2.93
2004	2	Int	0104S11683	7.3	44.2	8.38	31.30	21.10	39.30	7.67	0.48	15.00	41.1	26.1	13.30	0.04	3.47
2004	3	Int	0104S14234	6.8	41.8	19.80	44.80	25.50	145.00	24.50	0.28	8.75	146.0	137.0	5.74	< 0.02	3.33
2004	4	Int	0104S16558	7.1	47.5	6.21	35.50	13.00	21.40	4.35	0.40	12.50	61.5	49.0	7.56	0.02	3.06
2005	1	Int	0105S01676	7.2	44.0	17.80	45.60	29.90	127.00	20.70	0.41	12.80	144.0	131.0	5.18	< 0.02	2.18
2005	2	Int	0105S03977	7.5	61.9	2.05	7.44	4.47	7.17	2.94	0.27	8.43	156.0	147.0	2.96	< 0.02	1.85
2005	3	Int	0105S08168	5.9	55.6	5.47	35.40	29.20	8.22	1.45	0.50	15.60	92.7	77.1	5.27	0.04	7.47
2005	4	Int	0105S14664	6.9	41.5	7.99	40.30	23.60	40.20	7.11	0.39	12.20	129.0	116.0	7.16	0.02	1.45
2006	1	Int	S0603345-001	7.3	55.6	2.55	4.79	2.62	17.10	8.88	0.23	7.29	83.9	76.6	1.04	< 0.02	3.01
2006	2	Int	S0606464-001	7.2	47.1	8.45	26.80	33.40	39.00	7.11	0.62	19.30	87.9	68.7	8.71	0.03	3.97
2006	3	Int	S0609044-001	7.1	45.6	8.74	38.30	30.40	32.20	5.50	0.31	9.73	115.0	105.0	10.00	0.04	2.61
2006	4	Int	S0612385-001	6.9	76.3	12.50	19.10	10.80	78.90	20.40	0.34	10.60	67.4	56.7	0.96	< 0.02	2.38
Minimum				5.9	35.2	1.02	2.65	2.22	4.11	1.45	0.23	7.29	26.9	15.4	0.96	< 0.02	1.06
Maximum				7.5	76.3	19.80	45.60	36.90	145.00	24.50	0.79	24.70	156.0	147.0	13.30	0.04	7.47
Average				7.1	49.0	7.11	25.78	17.77	35.44	7.62	0.45	13.91	80.3	66.3	6.03	0.02	2.59

**Riparian Plant Communities
in the
East Fork of Box Canyon
July 2006**



**A Vegetation Monitoring Study
for the
SUFCO Mine:
July 2006**

Prepared by

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RE-13	76
R-07	80
R-09	84
R-11	88
R-13	92
R-15	96

SCOPE

Quantitative and qualitative baseline vegetation data were recorded in several locations in the East Fork of Box Canyon in **July 2006**. Data were also recorded in several locations in the Main Fork of Box Canyon. These data sets may be used for controls in 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 *sixth* 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 *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 *third* sample period was in October 2004 (*Riparian Plant Communities in the East Fork of Box Canyon: October 2004*). The *fourth* sample period was in July 2005 (*Plant Communities in the East Fork of Box Canyon: July 2005*). The *fifth* sample period was in October 2005 (*Plant Communities in the East Fork of Box Canyon: October 2005*).

INTRODUCTION

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.

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 (DOG M), 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 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 began to be recorded again 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.

With the one exception to the protocol modification mentioned above, the parameters for all sample stations in the 2003, 2004, 2005, and 2006 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 and perpendicular to it. 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 July 2006 in the East Fork and Main Fork of Box Canyon have been included in this report. USDA Forest Service protocol and other methods were employed to monitor the riparian areas. These methods utilized the 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 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 October 2003, July 2004, October 2004, July 2005, October 2005, and July 2006. Five of these previous 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 later. 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.

As suggested in the two previous monitoring reports (July 2005 and October 2005) sample period), upon scrutinizing the data sets for each sample period, *the Community Cover and Green Line Methods appear to be more conducive to noting changes in the riparian plant communities.*

Monitoring reports from previous sample periods suggested that many of the riparian communities in the East Fork of Box Canyon decreased, especially between October 2003 and July 2004. At other sample locations, it has been reported previously that little change was noticed. Other than the spring areas which will be discussed separately, the trend since that time was for the communities to stabilize and then begin to somewhat increase over time. However, during the sample periods from which this report was based (July 2006), a large storm event (1.2 inches or rain in less than 1 hour; personal communications with Erik Petersen) occurred and caused severe bank erosion along the riparian corridors of the East Fork of Box Canyon. This event was observed by the author. Photographs in this report (*and others on file*) and data herein reflect this event.

Summaries have been prepared that compared all data recorded from the sample periods of October 2003 through October 2005. These findings were reported in the final report called: *Plant Communities in the East Fork of Box Canyon: October 2005*. Similarly, another summary will be prepared for these data that include the data from sampling in July 2006 and October 2006. These findings will be provided in the final report for the next sample period, or October 2006.

RIPARIAN COMPLEX DATA SHEET
July 2006

CLIENT: Canyon Fuel Company

COMPLEX: Number EFB-1

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 18 - 21, 2006

OBSERVER(S): P.D. Collins

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: West

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: $\sim 1^{\circ}$

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

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 800 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)
<i>Picea pungens</i>	<i>Potentilla fruticosa</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Rosa woodsii</i>		<i>Carex hoodii</i>
			<i>Carex lanuginosa</i>
			<i>Juncus longistylis</i>
			<i>Juncus arcticus</i>
			<i>Poa pratensis</i>

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: 65 (more if I included moss)

% bank length unvegetated, stable: 35

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

BANK STABILITY: 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; 32 ft. transect on right side (59 ft; includes uplands).
- 3) Cattle grazed this year. Much of vegetation was grazed short, so plant identifications were

difficult.

- 4) The area was dry when I recorded the data; by the time I came back to it later a large storm event had filled the area used to pond water.
- 5) The previous Greenline data summaries did not include upland (and rightly so).

DATA SUMMARIES

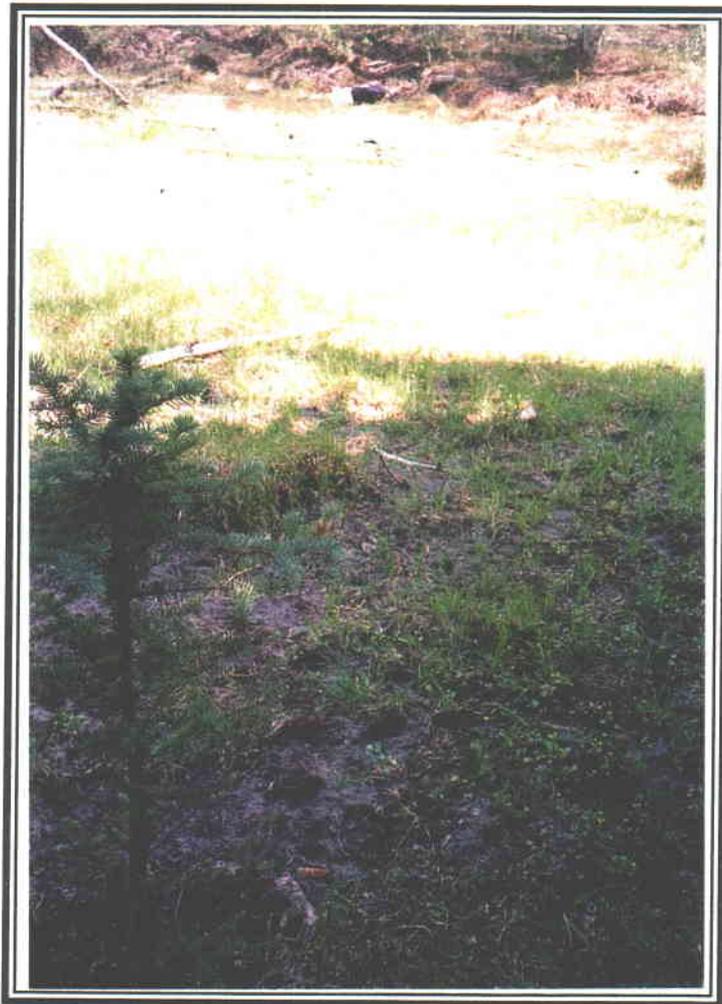
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-1 (see Note #5)		Left	24.5	<i>Carex lanuginosa</i> / <i>Agrostis stolonifera</i>
		Right	24.5	<i>Carex lanuginosa</i> / <i>Agrostis stolonifera</i>
		Channel	n/a	Dry (no standing water)
		Upland	10.0	

EFB-1: Cover using point quadrats (July 2006).

COVER BY SPECIES	PERCENT
TREES & SHRUBS	
FORBS	
<i>Taraxacum officinale</i>	5.26
GRASSES	
<i>Agrostis stolonifera</i>	5.26
<i>Carex lanuginosa</i>	42.11
<i>Juncus longistylis</i>	5.26
TOTAL COVER	
LIVING COVER (vascular)	57.89
WATER	
MOSS	
LITTER	15.79
B/G	15.79
ROCK	10.53
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-1

RIPARIAN COMPLEX DATA SHEET

July 2006

CLIENT: Canyon Fuel Company

COMPLEX: Number EFB-2

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 18 - 21, 2006

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°

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

APPARENT FORAGE TREND: more or less stable

ESTIMATED FORAGE PRODUCTION: 200 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)
<i>Pinus ponderosa</i>	<i>Artemisia tridentata</i>	<i>Achillea millefolium</i>	<i>Juncus arcticus</i>
<i>Populus tremuloides</i>	<i>Potentilla fruticosa</i>	<i>Aster sp.</i>	<i>Agrostis stolonifera</i>
		<i>Equisetum arvense</i>	<i>Poa pratensis</i>
		<i>Potentilla sp.</i>	<i>Poa secunda</i>
		<i>Taraxacum officinale</i>	<i>Juncus longistylis</i>
			<i>Carex lanuginosa</i>

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: 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. Site was dry. Lots of bareground
- 2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 25 ft. transect on right side (49 ft; includes uplands).
- 3) Grazing by cattle this year.
- 4) Meadow was dominated by Kentucky bluegrass.
- 5) Site seemed dryer this sample period with less redtop, rushes and wiregrass. It was difficult to see a well-defined riparian zone.

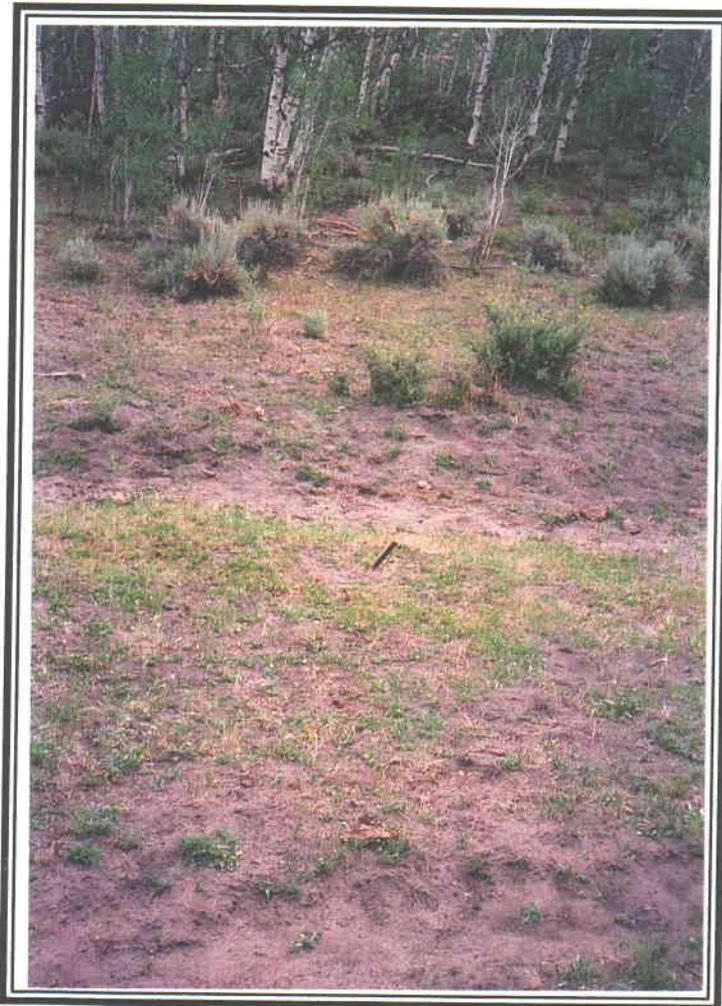
DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-2		Left	11.0	<i>Agrostis stolonifera/Juncus arcticus</i>
		Right	5.0	<i>Agrostis stolonifera/Juncus arcticus</i>
		Channel	3.0+	Dry

EFB-2: Cover using point quadrats (July 2006).	
COVER BY SPECIES	PERCENT
TREES & SHRUBS	
FORBS	
<i>Achillea millefolium</i>	6.25
<i>Aster</i> sp.	6.25
<i>Taraxacum officinale</i>	12.50
GRASSES	
<i>Juncus arcticus</i>	18.75
<i>Poa pratensis</i>	6.25
TOTAL COVER	
LIVING COVER (vascular)	50.00
STREAM	
MOSS	
LITTER	18.75
B/G	31.25
ROCK	
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-2

RIPARIAN COMPLEX DATA SHEET

July 2006

CLIENT: Canyon Fuel Company
 COMPLEX: Riverine - Number EFB-3
 WATERBODY NAME: East Fork Box Canyon
 LOCATION: Southern Wasatch Plateau, Utah
 DATE: July 18 - 21, 2006
 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: 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)
<i>Pinus ponderosa</i>	<i>Artemisia tridentata</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Lepidium latifolia</i>	<i>Carex lanuginosa</i>
		<i>Taraxacum officinale</i>	<i>Juncus arcticus</i>
		<i>Eriogonum sp.</i>	<i>Poa fendleriana</i>
			<i>Poa pratensis</i>

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: *80*

% bank length unvegetated, stable: *20*

% 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; 25 ft. transect on left side; 24 ft. transect on right side. (49 ft; includes uplands).

2) Probable grazing by cattle this year.

3) Dry, not water.

4) Cattle trail in left side of riparian vegetation may influence green line measurements.

DATA SUMMARIES

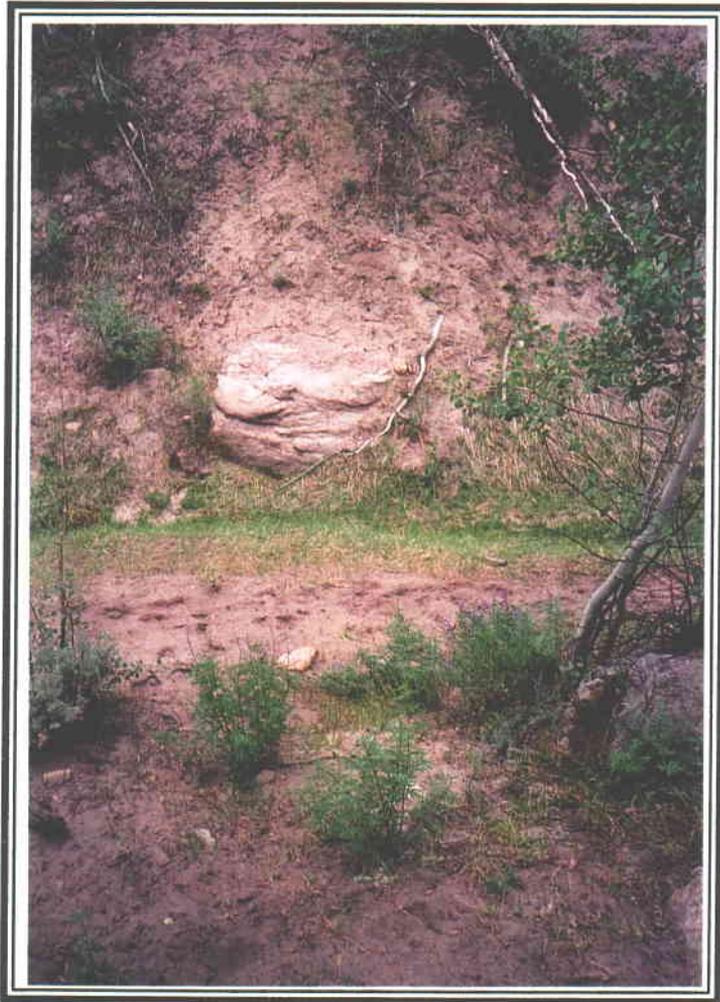
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-3		Left	3.5	<i>Agrostis stolonifera/Juncus arcticus/Carex lanuginosa</i>
		Right	3.5	<i>Agrostis stolonifera/Juncus arcticus/Carex lanuginosa</i>
		Channel	n/a	Dry

EFB-3: Cover using point quadrats (July 2006).

COVER BY SPECIES	PERCENT
TREES & SHRUBS	
FORBS	
<i>Eriogonum sp.</i>	6.25
<i>Lupinus sp.</i>	6.25
<i>Equisetum arvense</i>	6.25
GRASSES	
<i>Carex lanuginosa</i>	6.25
<i>Poa pratensis</i>	6.25
TOTAL COVER	
LIVING COVER (vascular)	31.25
WATER	
MOSS	
LITTER	25.00
B/G	43.75
ROCK	
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-3

RIPARIAN COMPLEX DATA SHEET
July 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-4

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 18 - 21, 2006

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: Unstable

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)
<i>Picea pungens</i>	<i>Artemisia tridentata</i>	<i>Antennaria sp.</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Chrysothamnus nauseosus</i>		<i>Juncus arcticus</i>
<i>Pinus ponderosa</i>	<i>Potentilla fruticosa</i>		<i>Poa fendleriana</i>
	<i>Rosa woodsii</i>		

POOL ATTRIBUTES

% area in pools: Dry

% 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: 25

% bank length unvegetated, stable: 40

% 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) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side (48 ft; includes uplands).

2) While here a very large storm event forced me to leave. Flooding was occurring. The flooding was eroding the banks and riparian zones severely. I later learned that the storm event was >1.2" of precipitation in less than 1 hour.

3) Grazing by cattle this year; site looked poor.

4) Site only had small riparian area, it appeared dryer.

DATA SUMMARIES

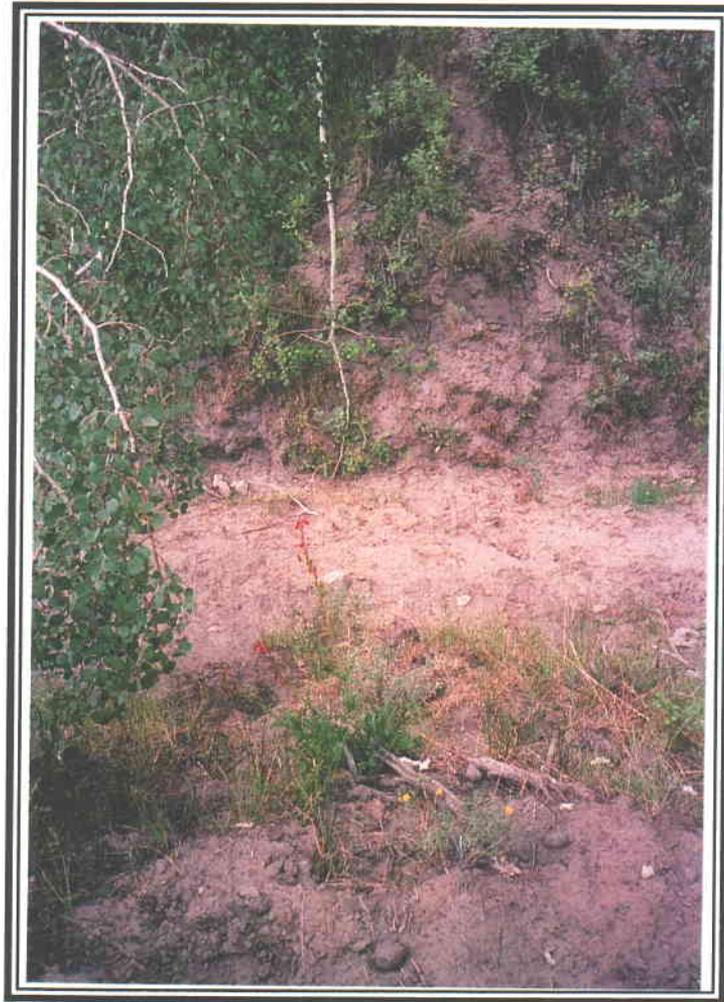
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-4		Left	0.5	<i>Equisetum arvense/Agrostis stolonifera</i>
		Right	2.0	<i>Equisetum arvense/Agrostis stolonifera</i>
		Channel	1.5	Dry

EFB-4: Cover using point quadrats (July 2006).

COVER BY SPECIES	PERCENT
TREES & SHRUBS	
FORBS	
<i>Penstemon eatonii</i>	6.67
GRASSES	
<i>Poa pratensis</i>	6.67
<i>Poa secunda</i>	20.00
TOTAL COVER	
LIVING COVER (vascular)	33.33
WATER	
MOSS	
LITTER	
B/G	60.00
ROCK	6.67
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-4

RIPARIAN COMPLEX DATA SHEET
July 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-5

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 18 - 21, 2006

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: 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)
<i>Picea pungens</i>	<i>Artemisia tridentata</i>	<i>Antennaria sp.</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Potentilla fruticosa</i>		<i>Poa fendleriana</i>
<i>Pinus ponderosa</i>	<i>Rosa woodsii</i>		<i>P. secunda</i>
	<i>Salix exigua</i>		<i>P. pratensis</i>
	<i>Symphoricarpos oreophilus</i>		

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: 30
- % 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) 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 (48 ft; includes uplands).
- 3) No water in channel in this location; seemed to be okay from recent flooding.
- 4) Little or no cattle sign observed.

DATA SUMMARIES

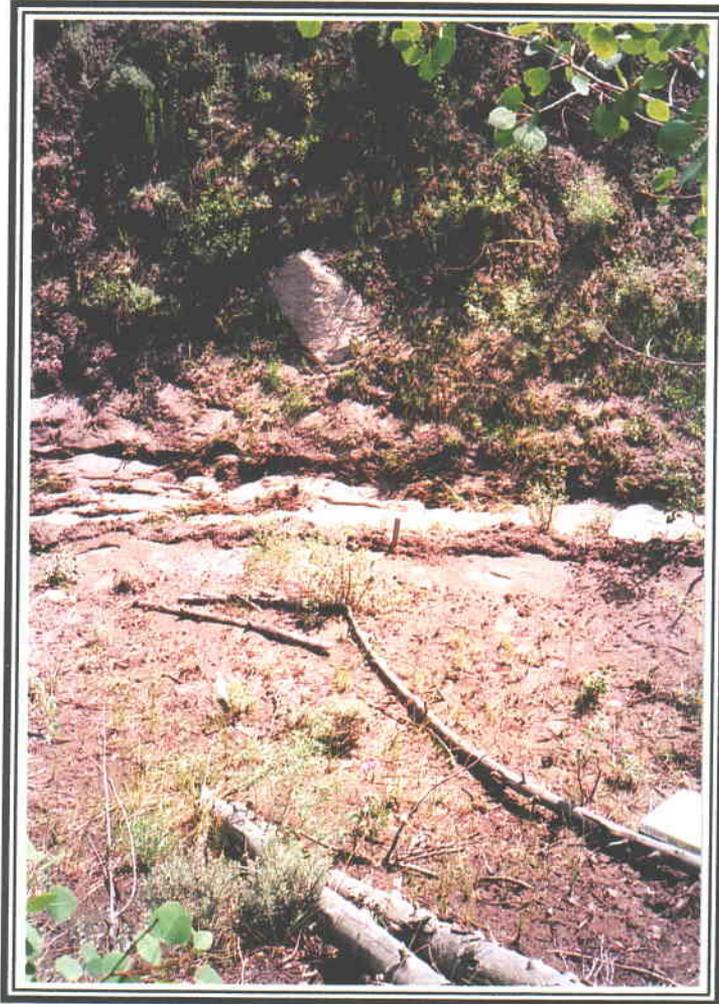
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-5		Left	3.0	<i>Agrostis stolonifera</i>
		Right	2.0	<i>Agrostis stolonifera</i>
		Channel	1.0	Dry

EFB-5 Cover using point quadrats (July 2006).

<u>COVER BY SPECIES</u>	<u>PERCENT</u>
TREES & SHRUBS	
<i>Populus tremuloides</i>	6.25
FORBS	
<i>Antennaria</i> sp.	6.25
GRASSES	
<i>Poa secunda</i>	18.75
<i>Poa pratensis</i>	12.50
TOTAL COVER	
LIVING COVER (vascular)	43.75
WATER	
MOSS	
LITTER	18.75
B/G	37.50
ROCK	
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-5

RIPARIAN COMPLEX DATA SHEET
July 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-6

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 18 - 21, 2006

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: unstable

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)
<i>Picea pungens</i>	<i>Amelanchier utahensis</i>	<i>Taraxacum officinale</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Potentilla fruticosa</i>	<i>Antennaria sp.</i>	<i>Bromus carinatus</i>
<i>Pinus ponderosa</i>	<i>Symphoricarpos oreophilus</i>	<i>Aster sp.</i>	<i>Juncus arcticus</i>
<i>Populus fremontii</i>	<i>Artemisia tridentata</i>	<i>Swertia radiata</i>	<i>Poa fendleriana</i>
		<i>Artemisia ludoviciana</i>	<i>Elymus trachycaulus</i>

POOL ATTRIBUTES

% area in pools: Dry

% 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°): (trail)

% bank length with overhanging vegetation: 10

BANK CONDITION

% bank length vegetated, stable: 20

% bank length unvegetated, stable: 35

% bank length vegetated, unstable: 10

% 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 (48 ft; includes uplands).
- 3) Little or no grazing by cattle this year. Dry this July, but water was just downstream but

cannot see from this location.

4) Cattle trail was on some of the riparian community and could affect results.

5) Area had much debris (some large) from previous 2 days of flooding.

DATA SUMMARIES

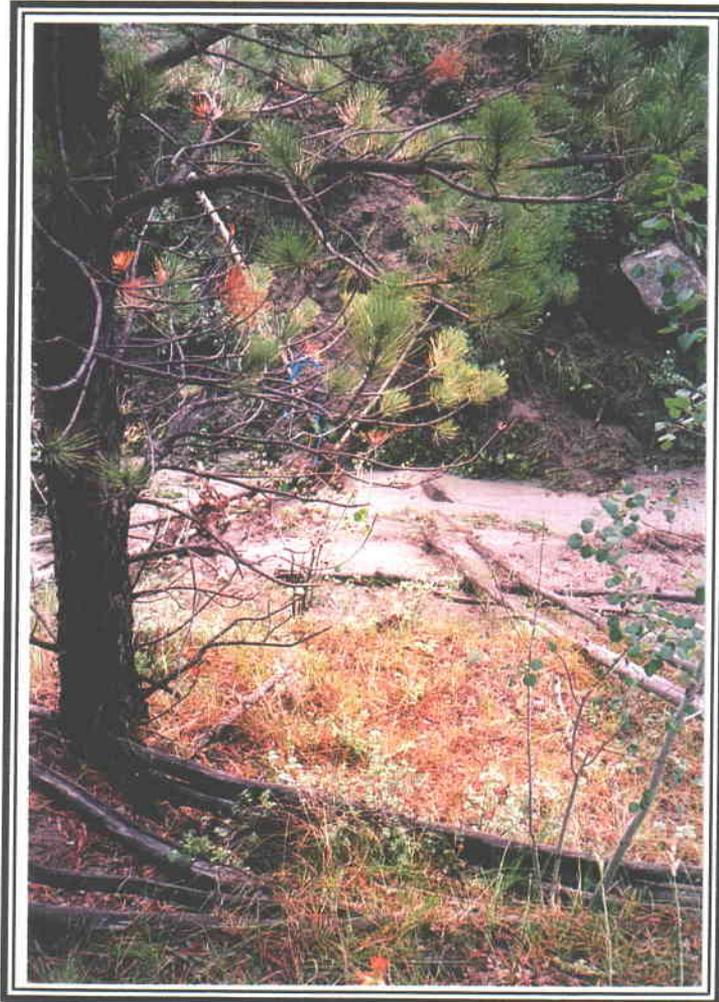
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-6		Left	1.5	<i>Agrostis stolonifera/Juncus arcticus</i>
		Right	1.0	<i>Agrostis stolonifera/Ranunculus cymbalaria</i>
		Channel	2.5	Dry

EFB-6 Cover using point quadrats (July 2006).

COVER BY SPECIES	PERCENT
TREES & SHRUBS	
<i>Populus tremuloides</i>	6.25
FORBS	
<i>Achillea millefolium</i>	6.25
GRASSES	
<i>Poa fendleriana</i>	25.00
<i>Poa pratensis</i>	12.50
TOTAL COVER	
LIVING COVER (vascular)	50.00
WATER	
MOSS	
LITTER	6.25
B/G	43.75
ROCK	
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-6

RIPARIAN COMPLEX DATA SHEET

July 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-7

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 18 - 21, 2006

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: Unstable

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)
<i>Picea pungens</i>	<i>Juniperus communis</i>	<i>Aster sp.</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Artemisia dracunculus</i>	<i>Poa fendleriana</i>
<i>Rosa woodsii</i>		<i>Castilleja sp.</i>	

POOL ATTRIBUTES

% area in pools: 70

% 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: 0

% bank length unvegetated, stable: 0

% bank length vegetated, unstable: 20

% bank length unvegetated, unstable: 80

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. Water was present.
- 2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side (48 ft; includes uplands).
- 3) Very unstable upper banks (above bankfull).
- 4) Little or no grazing in this area.
- 5) Much side slope movement on right and left sides.

- 6) This area seemed to have much more bedrock exposed with less soil on left bank along the riparian channel. This was probably a result of the recent flooding (> 1.2" in less than 1 hr.). A comparison of the greenline data will be interesting.
 7) Aspens have fallen since early data (see photos).

DATA SUMMARIES

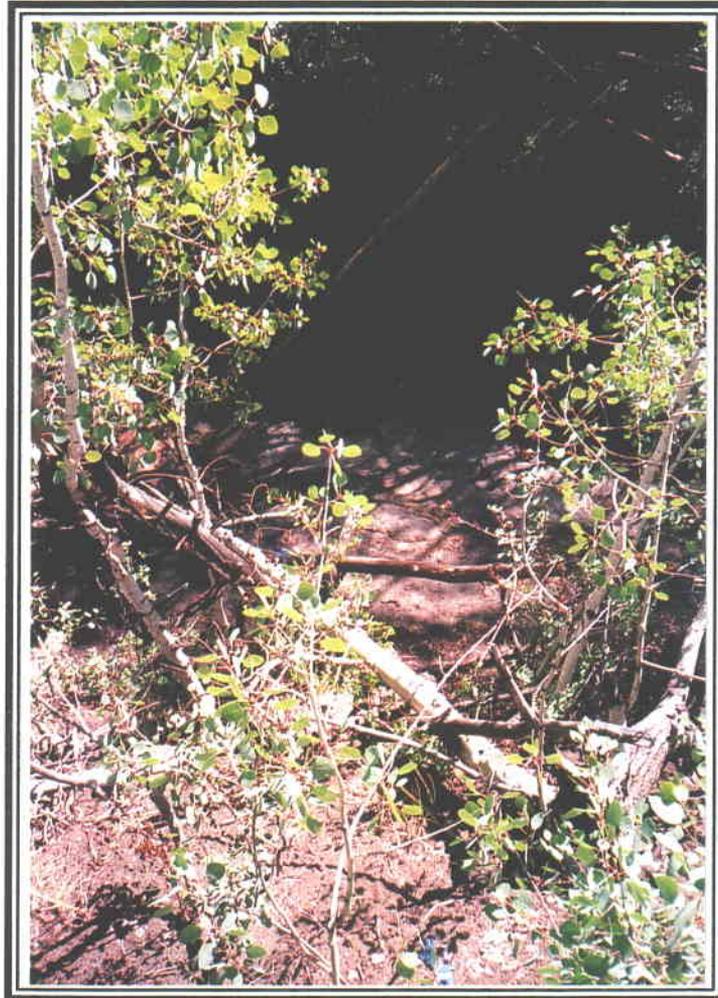
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-7		Left	1.0	<i>Agrostis stolonifera</i>
		Right	0	
		Channel Water	2.0 1.5	Rock Water

EFB-7 Cover using point quadrats (July 2006).

COVER BY SPECIES	PERCENT
TREES & SHRUBS	
<i>Populus tremuloides</i>	12.50
FORBS	
<i>Artemisia dracuncululus</i>	12.50
<i>Galium aparine</i>	6.25
GRASSES	
<i>Agrostis stolonifera</i>	
TOTAL COVER	
LIVING COVER (vascular)	31.25
WATER	6.25
MOSS	
LITTER	25.00
B/G	12.50
ROCK	25.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-7

RIPARIAN COMPLEX DATA SHEET

July 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-8

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 18 - 21, 2006

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: Unstable

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)
<i>Picea pungens</i>	<i>Symphoricarpos oreophilus</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Achillea millefolium</i>	<i>Poa fendleriana</i>
<i>Pinus ponderosa</i>		<i>Penstemon sp.</i>	<i>P. pratensis</i>
		<i>Antennaria sp.</i>	
		<i>Equisetum arvensis</i>	
		<i>Potentilla sp.</i>	

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: 10

BANK CONDITION

- % bank length vegetated, stable: 20
- % bank length unvegetated, stable: 30
- % bank length vegetated, unstable: 20
- % 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) Beginning to see more blue spruce and less ponderosa pine in uplands in this area.
- 2) Quantitative Methods: This is a difficult area to monitor because there is a spring on the right side with water flowing from it. The information above is for the main channel.

- 3) For the point quads, the transect crossed the spring community too (transect total = 54 ft). *I did not count the "island" between the two as riparian* (but I may have previously). Perhaps it could all be considered riparian. For both separate data, see the Green Line method below.
- 4) The area has had severe flooding in the last couple of days. The bank was cut down ~ 3 ft lower than the previous elevations. There was a great deal of debris in the area. The small green conifer in the area was downed (compare photographs with previous sample periods). Riparian communities have been impacted by the flooding.
- 5) No cattle sign this year.

DATA SUMMARIES

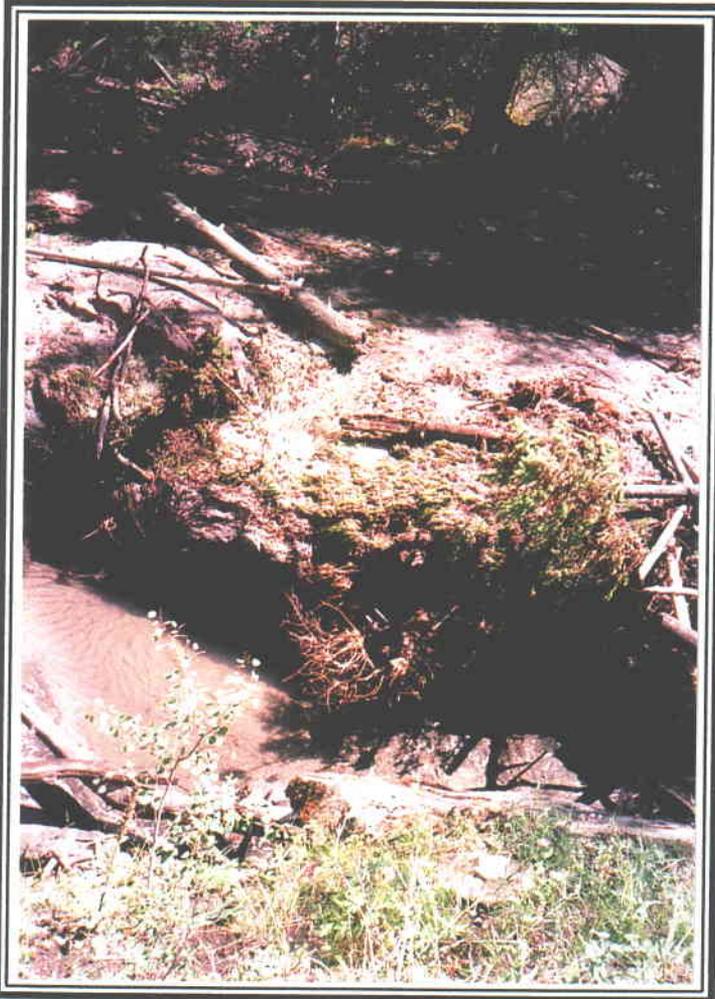
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-8 Main Channel		Left	2.0	<i>Equisetum arvensis/Agrostis stolonifera</i>
		Right	3.0	<i>Equisetum arvense</i>
		Channel	2.0 1.0 6.0	Rock Bareground Water
EFB-8 Spring Channel		Left	2.0	<i>Agrostis stolonifera/Equisetum arvense</i>
		Right	1.0	<i>Agrostis stolonifera/Equisetum arvense</i>
		Channel	0.5 6.0	Water Bareground
Total w/island			38.5	

EFB-8 Cover using point quadrats (July 2006).

COVER BY SPECIES	PERCENT
TREES & SHRUBS	
<i>Populus tremuloides</i>	5.56
<i>Rosa woodsii</i>	11.00
FORBS	
<i>Equisetum arvense</i>	5.56
GRASSES	
<i>Agrostis stolonifera</i>	22.22
TOTAL COVER	
LIVING COVER (vascular)	44.44
WATER	11.11
MOSS	
LITTER	16.67
B/G	22.22
ROCK	5.56
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-8

RIPARIAN COMPLEX DATA SHEET

July 2006

CLIENT: Canyon Fuel Company

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

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 18 - 21, 2006

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)
<i>Picea pungens</i>	<i>Ribes sp.</i>	<i>Equisetum arvensis</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Rosa woodsii</i>		
<i>Salix amygdaloides</i>	<i>Symphoricarpos oreophilus</i>		

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°): 0

% bank length with overhanging vegetation: 35

BANK CONDITION

% bank length vegetated, stable: 15

% bank length unvegetated, stable: 40

% bank length vegetated, unstable: 5

% 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) Bank cut on right side, but now more on left.

2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals for 38 ft.(see below).

In addition, the USDA Forest Service Protocol for Level III was employed by measuring the plant communities using the line intercept method.

3) Little or no grazing by cattle this year.

4) For point quadrats we had different transect lengths: Oct 03 (50 ft), July 04 (50 ft), Oct 04 (32 ft or 38 ft); July 05 (38 ft); Oct 05 (38 ft); July 06 (38'). 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. *Note that comparisons of these data can be confusing because pt. quad transects were sometimes different than line transects.*

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	2.0	<i>Equisetum arvense</i>
		Right	1.0	<i>Equisetum arvense</i>
		Channel	2.0	Water

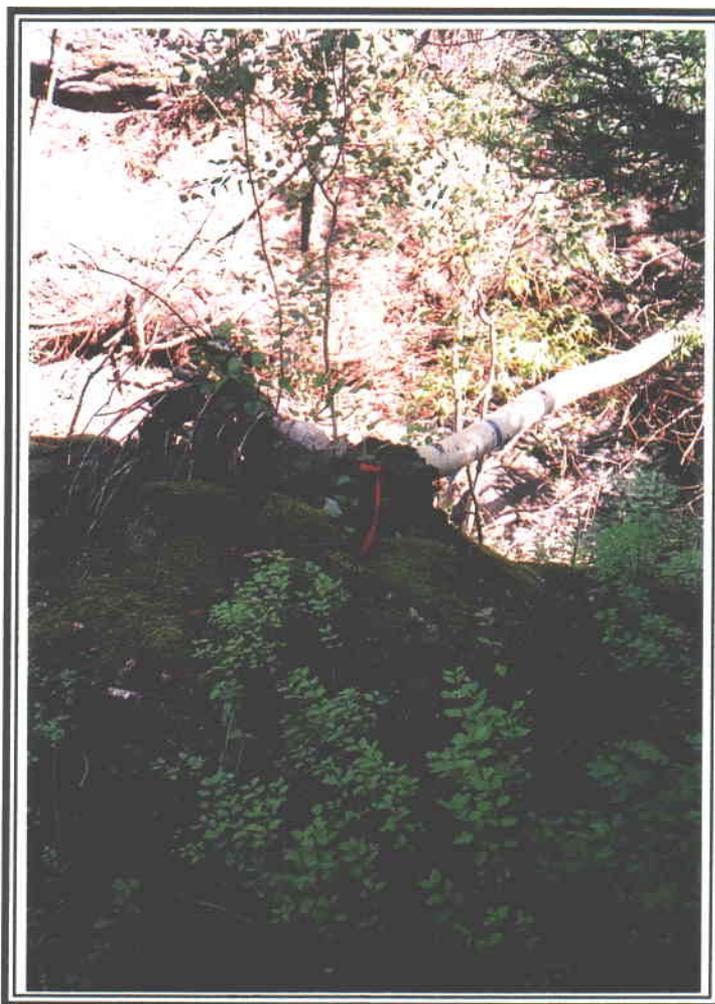
RE-10 (EFB-9) Cover using point quadrats (July 2006).

COVER BY SPECIES	PERCENT
TREES & SHRUBS	
<i>Ribes aureum</i>	8.33
<i>Symphoricarpos oreophilus</i>	8.33
FORBS	
<i>Geranium richardsonii</i>	8.33
GRASSES	
TOTAL COVER	
LIVING COVER (vascular)	25.00
WATER	8.33
MOSS	8.33
LITTER	41.67
B/G	16.67
ROCK	
TOTAL	100.00

EFB-09 (RE-10): Cover by community types in Box Canyons (July 2006)

USDA Forest Service Protocol (1992)	Cover (ft)
UPLAND VEGETATION	
<i>Populus tremuloides/Picea pungens</i>	19.00
<i>Populus tremuloides/Rosa woodsii</i>	10.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Equisetum arvensis</i>	3.00
TOTAL COVER (Upland Species)	29.00
TOTAL COVER (Riparian Species)	3.00
BAREGROUND	0.00
ROCK	4.00
WATER/MUD/DRY CHANNEL	2.00
Moss	0.00
TOTAL COVER	38.00

PHOTOGRAPHIC DOCUMENTATION



EFB-9 (RE-10)

RIPARIAN COMPLEX DATA SHEET

July 2006

CLIENT: Canyon Fuel Company

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

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 18 - 21, 2006

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk

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: Unstable.

APPARENT FORAGE TREND: Unstable

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)
<i>Picea pungens</i>	<i>Salix sp.</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Rosa woodsii</i>	<i>Geranium richardsonii</i>	
<i>Betula occidentalis</i>		<i>Equisetum arvense</i>	
		<i>Epilobium angustifolium</i>	

POOL ATTRIBUTES

% area in pools: 70

% 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°): 10

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

% bank length with overhanging vegetation: 20

BANK CONDITION

% bank length vegetated, stable: 60

% bank length unvegetated, stable: 30

% 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) Just beginning to see river birch in this area.
- 2) Quantitative Methods: There were two transect lines here because of the older (1999) study. One was 28 ft (from 1999) and one was 36 ft (team study). For point quadrats for Oct 2005, we sampled at 3 ft. intervals for the 28 ft transect line. I also sampled on 36 ft line (left in raw data). Regarding the two pt. quad transect lines (28 ft and 36 ft) for July 2006, I sampled the 36 ft line.
 In addition, the USDA Forest Service Protocol for Level III was employed by measuring the plant communities using the line intercept method (I used a 36 ft transect line in Oct 2005 and July 2006 which was *not consistent with July 2005*).
- 3) Right 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 above this station.
- 5) Photo taken from left side.
- 6) Negligible grazing by cattle this year.
- 7) There was lots of bareground that I counted in the upland community.
- 8) There were some small live blue spruce trees downed due to flooding and side slope movement.
- 9) Very unstable area at this time.

DATA SUMMARIES

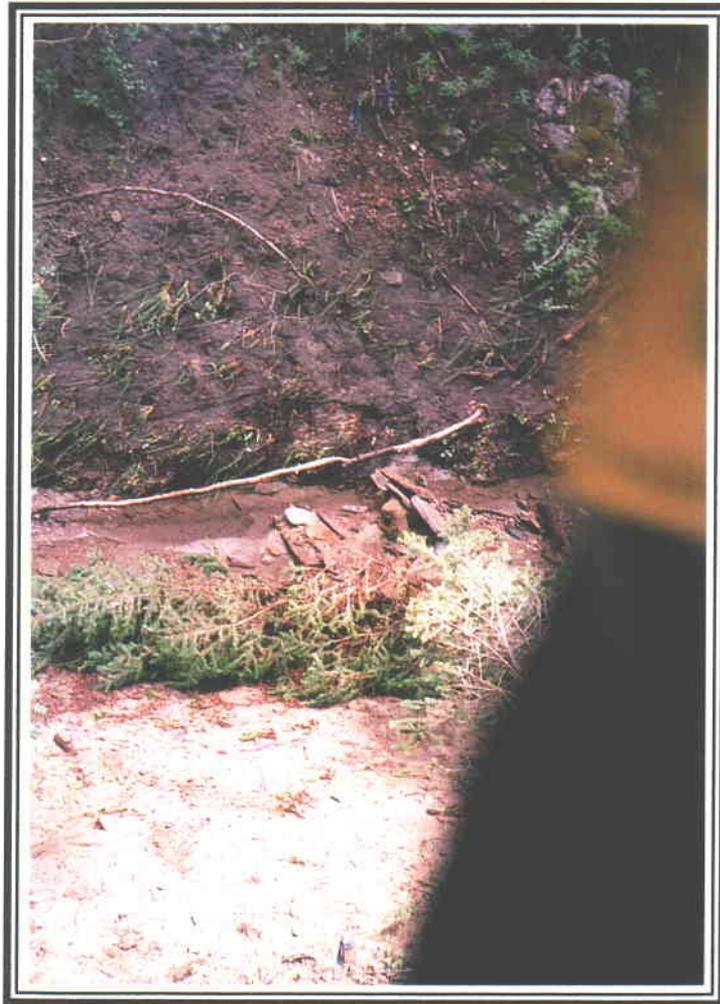
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-10	RE-09	Left	1.0	<i>Equisetum arvense</i> / <i>Geranium richardsonii</i>
		Right	1.0	<i>Agrostis stolonifera</i> / <i>Equisetum arvense</i>
		Channel	1.5 1.5	Water Bareground

RE-9 (EFB-10) Cover using point quadrats (.July 2006).	
COVER BY SPECIES	PERCENT
TREES & SHRUBS	
<i>Symphoricarpos oreophilus</i>	8.33
FORBS	
<i>Epilobium angustifolium</i>	8.33
<i>Equisetum arvense</i>	
GRASSES	
<i>Agrostis stolonifera</i>	
TOTAL COVER	
LIVING COVER (vascular)	16.67
WATER	8.33
MOSS	
LITTER	25.00
B/G	33.33
ROCK	16.67
TOTAL	100.00

EFB -10 (RE-09): Cover by community types in Box Canyons (July 2006)	
USDA Forest Service Protocol (1992)	
	Cover (ft)
UPLAND VEGETATION	
<i>Populus tremuloides</i>	31.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Geranium richardsonii/Equisetum arvense</i>	2.00
TOTAL COVER (Upland Species)	31.00
TOTAL COVER (Riparian Species)	2.00
BAREGROUND	0.00
ROCK	1.50
WATER/MUD/DRY CHANNEL	1.50
Moss	0.00
TOTAL COVER	36.00

PHOTOGRAPHIC DOCUMENTATION



EFB-10 (RE-09)

RIPARIAN COMPLEX DATA SHEET

July 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-11

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 18 - 21, 2006

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: Unstable due to recent flooding.

APPARENT FORAGE TREND: Unstable

ESTIMATED FORAGE PRODUCTION: 100 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)
<i>Picea pungens</i>	<i>Pachystima myrsinites</i>	<i>Cirsium sp.</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Symphoricarpos oreophilus</i>	<i>Geranium richardsonii</i>	<i>Juncus longistylis</i>
<i>Salix sp.</i>		<i>Equisetum arvense</i>	<i>Poa fendleriana</i>
<i>Cornus sericea</i>			
<i>Betula occidentalis</i>			

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°): 0

% bank length with overhanging vegetation: 20

BANK CONDITION

% bank length vegetated, stable: 30

% 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) This site is just below the confluence of a spring (EFB-S1)
- 2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals on a 45 ft transect line.
- 3) Little or no grazing by cattle this year.
- 4) Flood took down or pushed over mature trees just upstream from sample site including river birch, willow, and dogwood (photographs taken).

DATA SUMMARIES

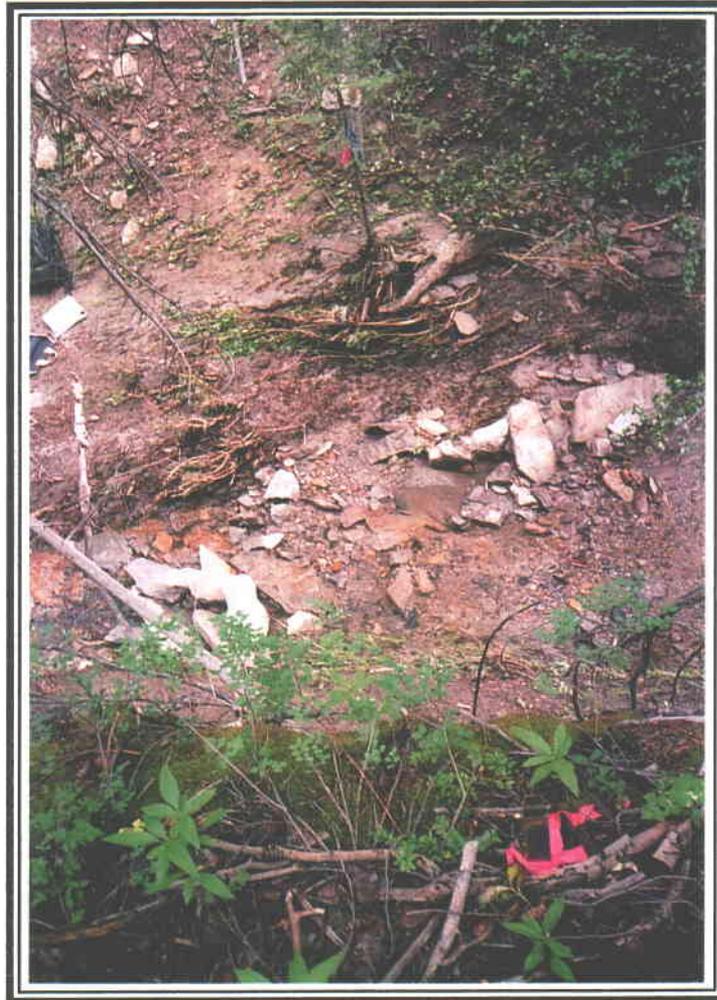
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-11		Left	1.0	<i>Equisetum arvense/Agrostis stolonifera</i>
		Right	2.0	<i>Equisetum arvense/Agrostis stolonifera</i>
		Channel	3.0 1.0	Water Rock

EFB-11 Cover using point quadrats (July 2006).

COVER BY SPECIES	PERCENT
TREES & SHRUBS	
<i>Picea pungens</i>	6.67
FORBS	
<i>Equisetum arvense</i>	
<i>Geranium richardsonii</i>	26.67
GRASSES	
<i>Juncus longistylis</i>	
TOTAL COVER	
LIVING COVER (vascular)	33.33
WATER	6.67
MOSS	13.33
LITTER	6.67
B/G	13.33
ROCK	26.67
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-11

RIPARIAN COMPLEX DATA SHEET
July 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-S1

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 18 - 21, 2006

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: unstable

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)
<i>Picea pungens</i>	<i>Salix sp.</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Symphoricarpos oreophilus</i>	<i>Ranunculus cymbalaria</i>	<i>Carex lanuginosa</i>
	<i>Rosa woodsii</i>	<i>Aster sp.</i>	<i>Elymus trachycaulus</i>
	<i>Lonicera involucrata</i>	<i>Geranium richardsonii</i>	<i>Juncus arcticus</i>
	<i>Betula occidentalis</i>		

POOL ATTRIBUTES

% area in pools: 5

% 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) Original stakes were gone. I put blue flagging and made a 37 ft transect line in Oct 2005; I used this line for July 2006.

4) Water in spring seems to be increasing compared to the last two sample periods.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

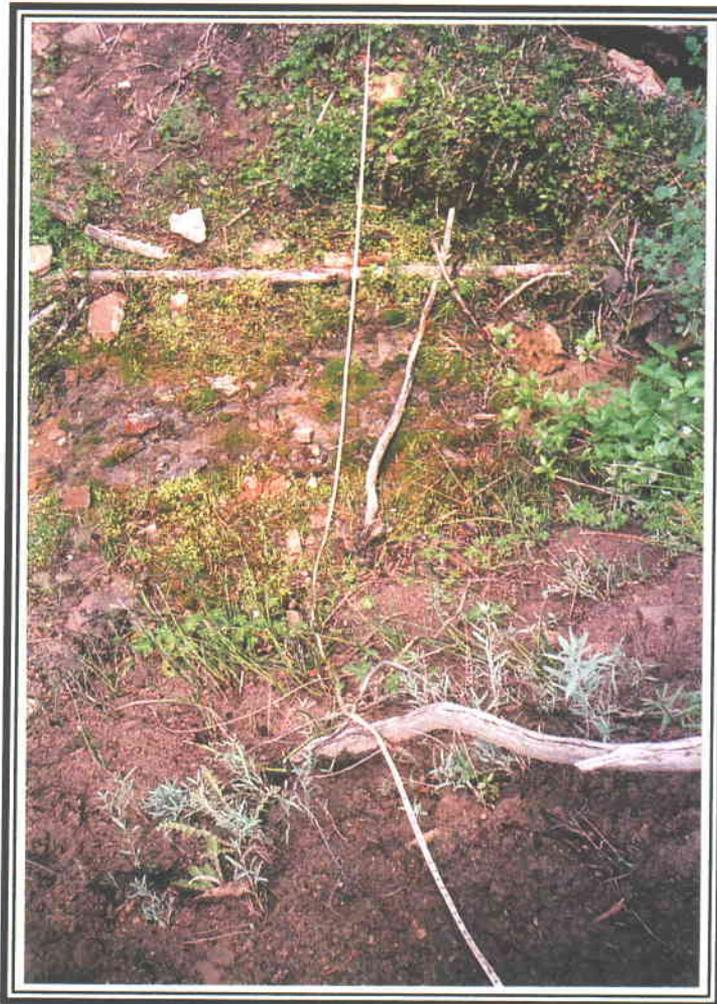
Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-S1		Left	6.0	<i>Equisetum arvense/Ranunculus cymbalaria</i>
		Right	6.0	<i>Equisetum arvense/Ranunculus cymbalaria</i>
		Channel	1.0	Water

EFB-S1: Cover by community types in Box Canyons (July 2006)

USDA Forest Service Protocol (1992)

	Cover (ft)
UPLAND VEGETATION	
<i>Aster/Bareground</i>	17
<i>Bromus carinatus</i>	7
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Ranunculus cymbalaria/Equisetum arvensis</i>	12
TOTAL COVER (Upland Species)	24.00
TOTAL COVER (Riparian Species)	12.00
BAREGROUND	0
ROCK	0
WATER/MUD/DRY CHANNEL	1
Moss	0
TOTAL COVER	37.00

PHOTOGRAPHIC DOCUMENTATION



EFB-S1

RIPARIAN COMPLEX DATA SHEET

July 2006

CLIENT: Canyon Fuel Company

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

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 18 - 21, 2006

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: Not climax, unstable.

APPARENT FORAGE TREND: Unstable

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)
<i>Picea pungens</i>	<i>Juniperus communis</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Equisetum arvense</i>	<i>Carex lanuginosa</i>
<i>Lonicera involucrata</i>		<i>Geranium richardsonii</i>	
<i>Betula occidentalis</i>			

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: 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) 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 again this sample period (Oct. 2005) 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. Yet some riparian or mesic species may be increasing such as horsetail, sedge and geranium.

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 on the previous transect line. Green Line: Also measured on transects.

4) As mentioned last sample period, some seeps may be beginning to form again below the sample area because riparian species such as *Carex lanuginosa* and other species were beginning to show up, but the historical spring still remains mostly absent.

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	10.0	<i>Carex lanuginosa</i>
		Right	10.0	<i>Agrostis stolonifera/Equisetum arvense/Carex lanuginosa</i>
		Channel	n/a	

EFB-S2 (EFB-12): Cover by community types in Box Canyons (July 2006)

USDA Forest Service Protocol (1992)

Cover (ft)

UPLAND VEGETATION

Populus tremuloides

59

RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

Equisetum arvensis/Carex lanuginosa

20

TOTAL COVER (Upland Species)

59.00

TOTAL COVER (Riparian Species)

20.00

BAREGROUND

0

ROCK

0

WATER/MUD/DRY CHANNEL

1

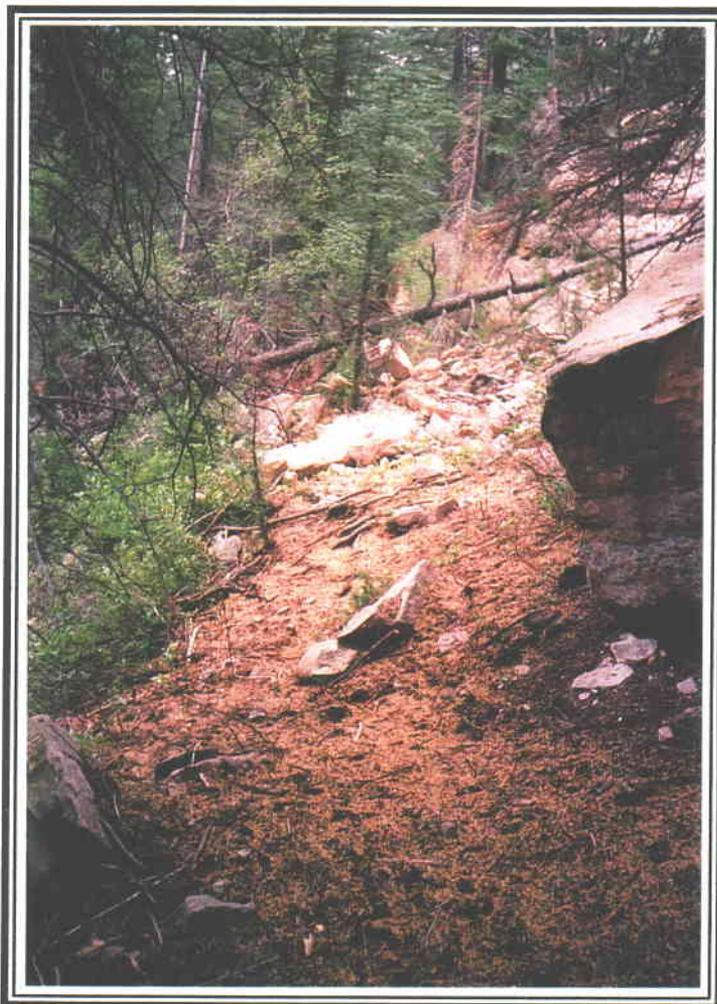
Moss

0

TOTAL COVER

79.00

PHOTOGRAPHIC DOCUMENTATION



EFB-S2 (EFB-12)

RIPARIAN COMPLEX DATA SHEET

July 2006

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 18 - 21, 2006

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: Unstable, no longer considered "climax".

APPARENT FORAGE TREND: unstable

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)
<i>Picea pungens</i>	<i>Symphoricarpos oreophilus</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Juniperus communis</i>	<i>Equisetum arvense</i>	<i>Elymus trachycaulus</i>
<i>Pinus ponderosa</i>	<i>Rosa woodsii</i>	<i>Geranium richardsonii</i>	
<i>Salix amygdaloides</i>			

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 (North)

% bank length vegetated, stable: 20

% bank length unvegetated, stable: 80

% 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 S3 (30 ft) and south S3 (31 ft) separately.
- 3) This spring area has gone dry.
- 4) Riparian species present but they have decreased since October 2003.
- 5) There were wetland/riparian species i.e. buttercup and redtop (see Green Line data).
- 6) The understory in the area was mostly bareground.
- 7) Difficult to call data here.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

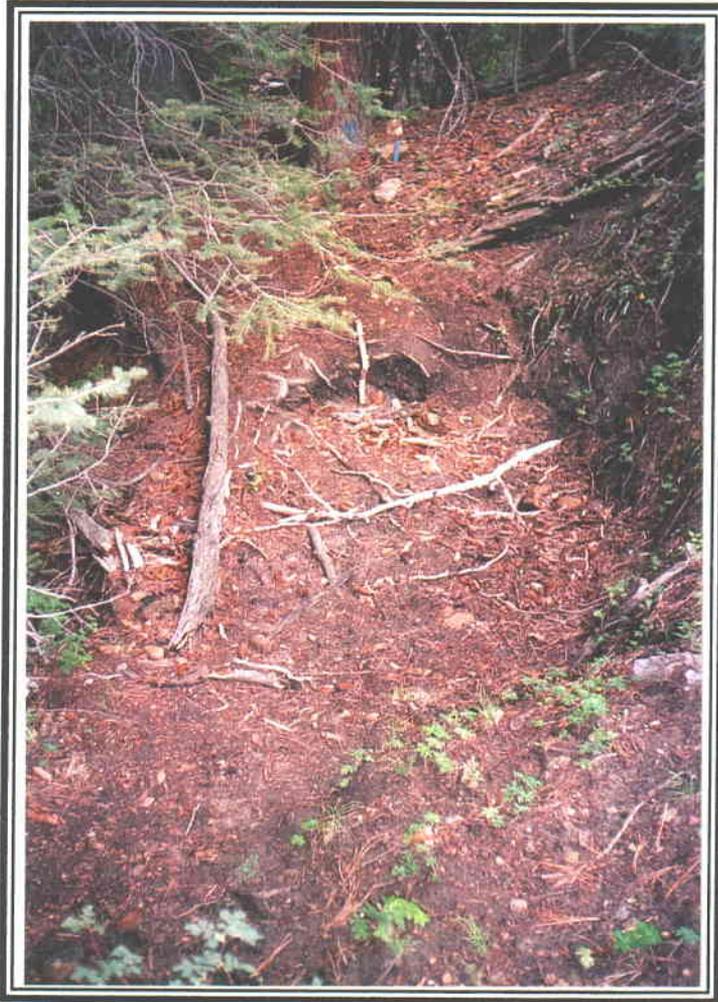
Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-S3	EFB-13	North	11.0	<i>Agrostis stolonifera/Ranunculus cymbalaria</i>
		South	0.0	
		Channel	n/a	

EFB-S3 (EFB-13): Cover by community types in Box Canyons (July 2006)

USDA Forest Service Protocol (1992)

	Cover (ft)
UPLAND VEGETATION	
<i>Populus tremuloides/Picea pungens</i>	50
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera/Ranunculus cymbalaria</i>	11
TOTAL COVER (Upland Species)	50.00
TOTAL COVER (Riparian Species)	11.00
BAREGROUND	0
ROCK	0
WATER/MUD/DRY CHANNEL	0
Moss	0
TOTAL COVER	61.00

PHOTOGRAPHIC DOCUMENTATION



EFB-S3 (EFB-13) South

RIPARIAN COMPLEX DATA SHEET

July 2006

CLIENT: Canyon Fuel Company

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

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 18 - 21, 2006

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: not climax.

APPARENT FORAGE TREND: Unstable

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)
<i>Picea pungens</i>	<i>Symphoricarpos oreophilus</i>	<i>Geranium richardsonii</i>	
<i>Populus tremuloides</i>	<i>Potentilla fruticosa</i>	<i>Equisetum arvense</i>	
<i>Salix amygdaloides</i>	<i>Rosa woodsii</i>		

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: 30

% bank length vegetated, unstable: 10

% 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) Spring area. There was a seep here first sample period (Oct 2003). It was dry leaving bareground for last sample periods. Some riparian species remain. The entire transect area was dominated by horsetail with some redtop this period.

- 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'm not sure why transect measure 19 ft this sample period, while other times it measures 25 ft. *Measured 19 ft this sample period.*

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	11.0	<i>Equisetum arvense</i>
		Right	4.0	<i>Equisetum arvense</i>
		Channel	4.0	Bareground

EFB-S4 (EFB-14): Cover by community types in Box Canyons (July 2006)

USDA Forest Service Protocol (1992)

Cover (ft)

UPLAND VEGETATION

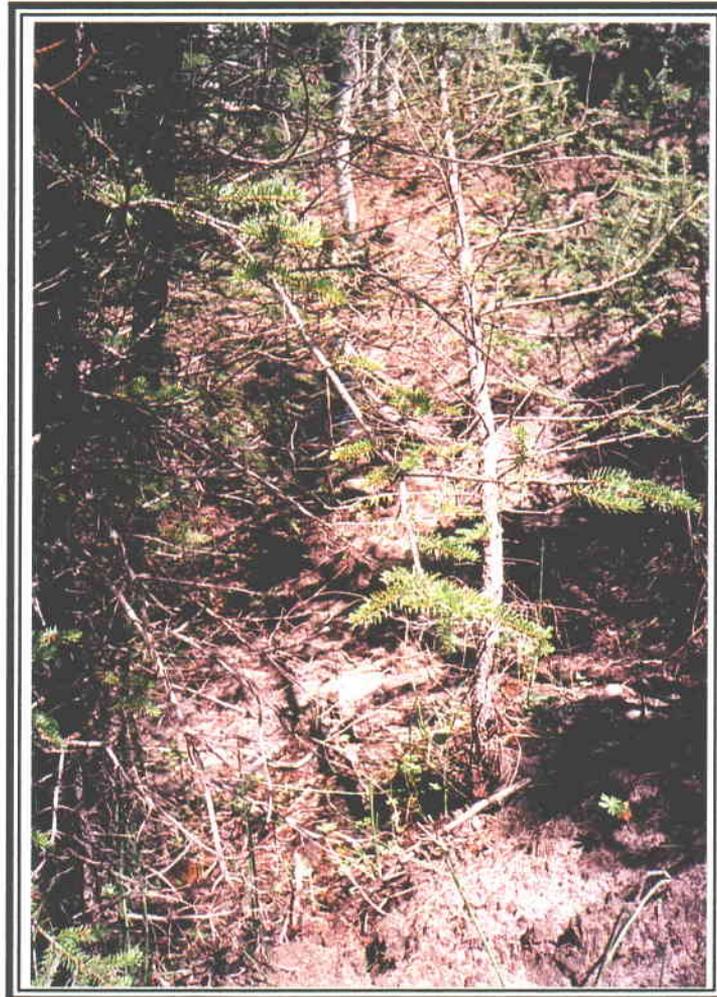
RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

<i>Equisetum arvensis</i>	15
TOTAL COVER (Upland Species)	0.00
TOTAL COVER (Riparian Species)	15.00
BAREGROUND	0
ROCK	4
WATER/MUD/DRY CHANNEL	0
Moss	0
TOTAL COVER	19.00

PHOTOGRAPHIC DOCUMENTATION



EFB-S4 (EFB-14)

RIPARIAN COMPLEX DATA SHEET
July 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number RE-11

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 18 - 21, 2006

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: decreasing

ESTIMATED FORAGE PRODUCTION: 75 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)
<i>Picea pungens</i>	<i>Rosa woodsii</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>			<i>Juncus longistylis</i>

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°): 80

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

% bank length with overhanging vegetation: 30

BANK CONDITION

% bank length vegetated, stable: 10

% bank length unvegetated, stable: 40

% bank length vegetated, unstable: 10

% bank length unvegetated, unstable: 40

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 in 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. Riparian species are returning here. In July 2005, right side had *Equisetum arvense* from hillside water. Last sample period (October 2005) had some *Equisetum arvense* and *Agrostis stolonifera*.

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) Recent flood evidence was obvious here with flattened vegetation (i.e. Wood's rose) and missing spruce tree. Also more erosional undercutting was observed. The upper left bank had more green vegetation that had moved downward (sloughing).
 4) I found early study stake under Wood's rose plants.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
RE-11		Left	1.5	<i>Equisetum arvense</i>
		Right	2.0	<i>Equisetum arvense</i>
		Channel	3.0 3.5	Water Rock

RE-11: Cover by community types in Box Canyons (July 2006)

USDA Forest Service Protocol (1992)

	Cover (ft)
<i>Populus tremuloides/Rosa woodsii</i>	19.00

RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

<i>Equisetum arvensis</i>	3.50
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TOTAL COVER (Upland Species) 19.00

TOTAL COVER (Riparian Species) 3.50

BAREGROUND 0.00

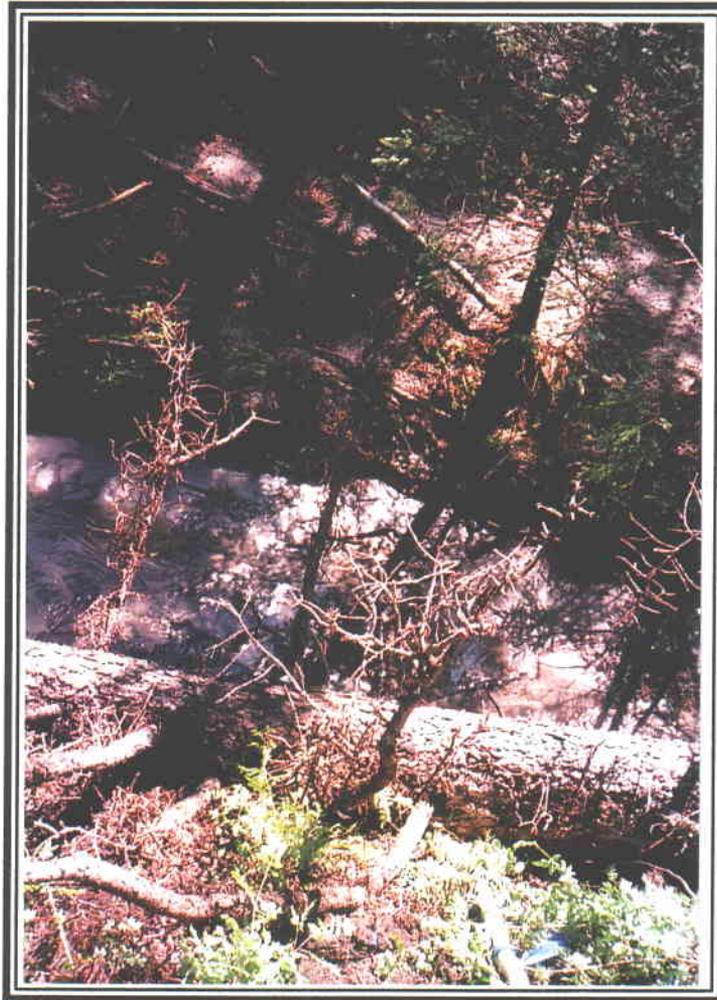
ROCK 3.50

WATER/MUD/DRY CHANNEL 3.00

Moss 0.00

TOTAL COVER 29.00

PHOTOGRAPHIC DOCUMENTATION



RE-11

RIPARIAN COMPLEX DATA SHEET

July 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number RE-12

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 18 - 21, 2006

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%

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: 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)
<i>Populus tremuloides</i>	<i>Salix sp.</i>	<i>Eriogonum sp.</i>	<i>Agrostis stolonifera</i>
<i>Salix sp.</i>	<i>Artemisia tridentata</i>	<i>Equisetum arvense</i>	<i>Juncus longistylis.</i>
	<i>Rosa woodsii</i>		<i>Juncus arcticus</i>
			<i>Poa secunda</i>

POOL ATTRIBUTES

% area in pools: 0 (but water present)
 % 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: 40
 % bank length unvegetated, stable: 10
 % bank length vegetated, unstable: 10
 % bank length unvegetated, unstable: 40

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.
- 4) Water was present.

5) Heavy flooding was observed July 19-20, 2006. Consequently, in many areas like this one, there was much debris 7-8 ft above the water level. Also there were lots of sediments within the riparian species, often covering them. Live aspen on the side slopes just above the stream had toppled (photographs are available).

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
RE-12		Left	2.0	<i>Juncus longistylis/Agrostis stolonifera</i>
		Right	1.0	<i>Juncus longistylis/Agrostis stolonifera</i>
		Channel	1.0 5.0	Water Bareground

RE-12: Cover by community types in Box Canyons (July 2006)

USDA Forest Service Protocol (1992)

	Cover (ft)
<i>Artemisia tridentata/Elymus trachycaulus</i>	10.00
<i>Populus tremuloides/Rosa woodsii</i>	10.00

RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

<i>Juncus longistylis/Agrostis stolonifera</i>	3.00
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TOTAL COVER (Upland Species) 20.00

TOTAL COVER (Riparian Species) 3.00

BAREGROUND 5.00

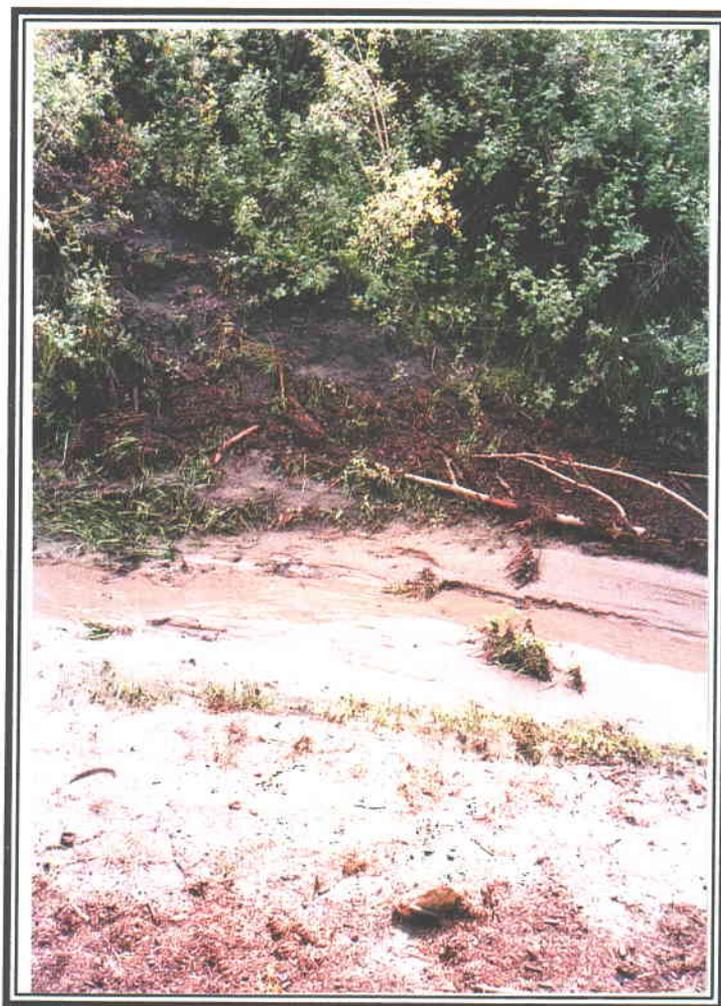
ROCK 0.00

WATER/MUD/DRY CHANNEL 1.00

Moss 0.00

TOTAL COVER 29.00

PHOTOGRAPHIC DOCUMENTATION



RE-12

RIPARIAN COMPLEX DATA SHEET

July 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number RE-13

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 18 - 21, 2006

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: NW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: $\sim 2^{\circ}$

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: 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)
<i>Picea pungens</i>	<i>Artemisia tridentata</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Potentilla fruticosa</i>	<i>Equisetum arvense</i>	<i>Carex lanuginosa</i>
<i>Pinus ponderosa</i>	<i>Symphoricarpos oreophilus</i>	<i>Artemisia dracunculus</i>	<i>Elymus trachycaulus</i>
		<i>Erigeron divergens.</i>	<i>Juncus sp.</i>
		<i>Achillea millefolium</i>	<i>Juncus arcticus</i>
		<i>Lupinus sp.</i>	

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: 10

BANK CONDITION

- % bank length vegetated, stable: 35
- % bank length unvegetated, stable: 50
- % 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) Site seemed to withstand the flooding well.
- 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	2.5	<i>Equisetum arvense/Agrostis stolonifera</i>
		Right	3.0	<i>Equisetum arvense/Agrostis stolonifera</i>
		Channel	2.0	Rock & Bareground

RE-13: Cover by community types in Box Canyons (July 2006)

USDA Forest Service Protocol (1992)

	Cover (ft)
<i>Artemisia tridentata/Elymus trachycaulus</i>	10.50
<i>Populus tremuloides</i>	10.00

RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

<i>Agrostis stolonifera/Equisetum arvensis</i>	5.50
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TOTAL COVER (Upland Species) 20.50

TOTAL COVER (Riparian Species) 5.50

BAREGROUND 2.00

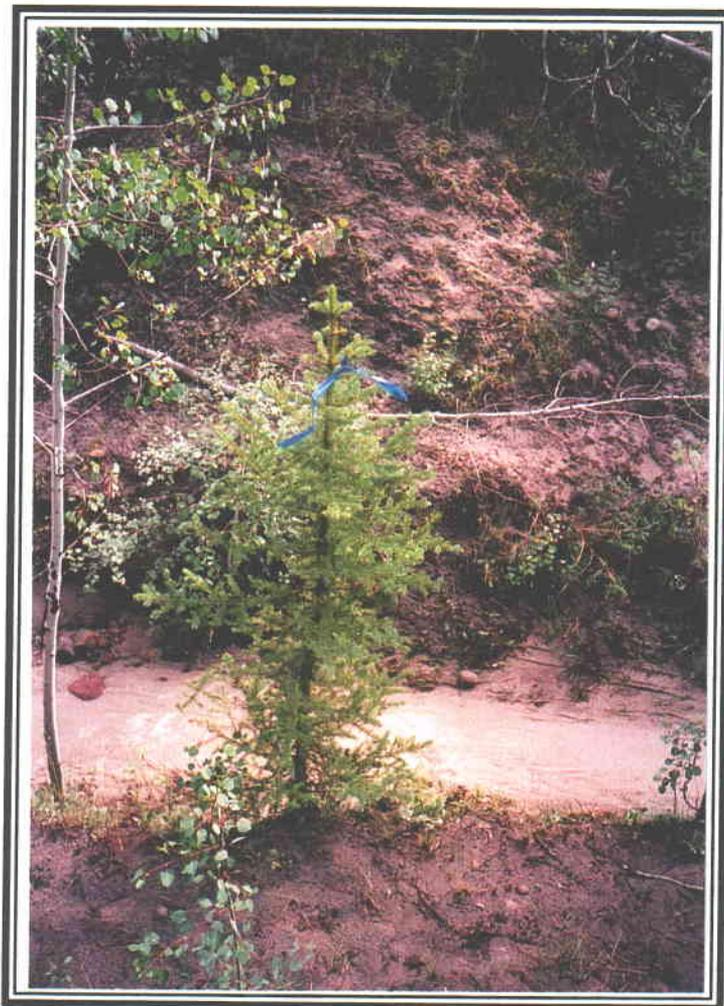
ROCK 0.00

WATER/MUD/DRY CHANNEL 0.00

Moss 0.00

TOTAL COVER 28.00

PHOTOGRAPHIC DOCUMENTATION



RE-13

RIPARIAN COMPLEX DATA SHEET

July 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-07

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 18 - 21, 2006

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)
<i>Picea pungens</i>	<i>Juniperus communis</i>	<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Potentilla fruticosa</i>	<i>Equisetum arvense</i>	<i>Carex lanuginosa</i>
<i>Betula occidentalis</i>		<i>Urtica dioica</i>	<i>Juncus longistylis</i>
		<i>Artemisia ludoviciana</i>	
		<i>Geranium richardsonii</i>	

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°): 30
- % bank length gently sloping (>135°): 35
- % bank length with overhanging vegetation: 35

BANK CONDITION

- % bank length vegetated, stable: 30
- % bank length unvegetated, stable: 40
- % bank length vegetated, unstable: 0
- % 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) 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) Area seemed to have little impact from recent flooding. I'm not sure as much rain hit this area.
- 4) Part of riparian spp. are in the channel.
- 5) No water at site.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-07		Left	4.5	<i>Agrostis stolonifera</i> / <i>Carex lanuginosa</i>
		Right	0.0	
		Channel	4.5 2.0	Bareground Rock

R-07: Cover by community types in Box Canyons (July 2006)

USDA Forest Service Protocol (1992)

	Cover (ft)
<i>Picea pungens</i>	11.00
<i>Populus tremuloides</i>	17.00

RIPARIAN VEGETATION

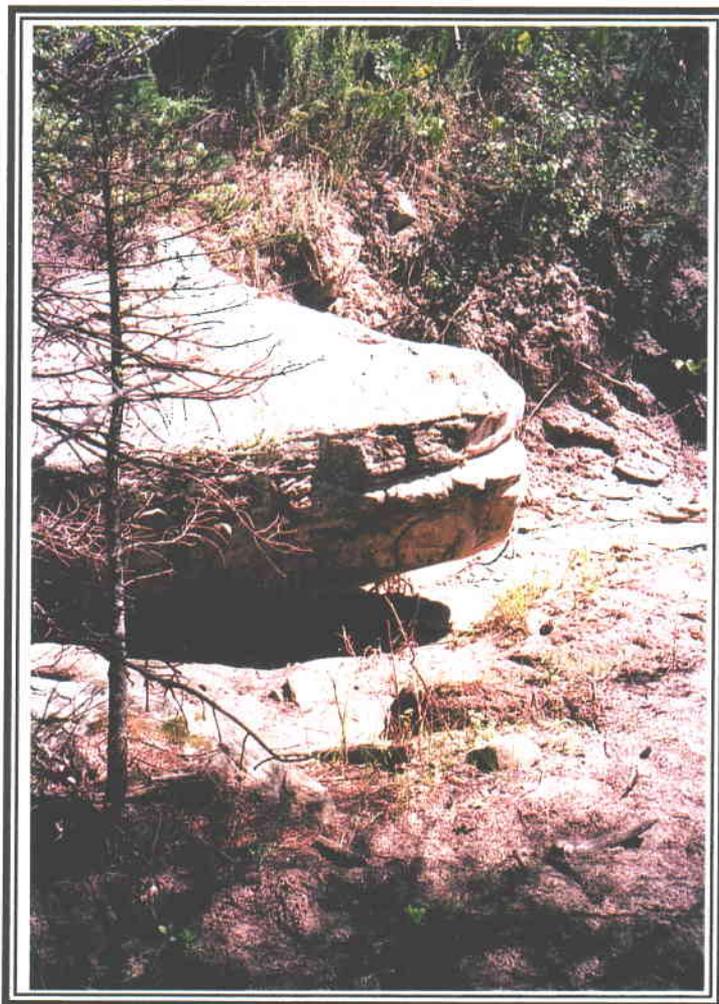
Dominant Woody Species

Dominant Herbaceous Species

<i>Carex lanuginosa</i> / <i>Agrostis stolonifera</i>	4.50
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TOTAL COVER (Upland Species)	28.00
TOTAL COVER (Riparian Species)	4.50
BAREGROUND	4.50
ROCK	2.00
WATER/MUD/DRY CHANNEL	0.00
Moss	0.00
TOTAL COVER	39.00

PHOTOGRAPHIC DOCUMENTATION



R-07

RIPARIAN COMPLEX DATA SHEET

July 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-09

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 18 - 21, 2006

OBSERVER(S): P.D. Collins

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: $\sim 2^\circ$

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: 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)
<i>Picea pungens</i>	<i>Salix lutea</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Equisetum arvense</i>	<i>Juncus longistylis</i>
<i>Juniperus scopulorum</i>	<i>Rosa woodsii</i>	<i>Urtica dioica</i>	<i>Juncus arcticus</i>

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°): 40

% bank length with overhanging vegetation: 50

BANK CONDITION

% bank length vegetated, stable: 75

% bank length unvegetated, stable: 10

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 15

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) The left side of the river had mostly riparian species. It was difficult to tell if it was from hillside water or stream. Seemed more like stream influence.
- 4) The right side had hillside water influence.

5) Area seemed to have little impact from recent flooding.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

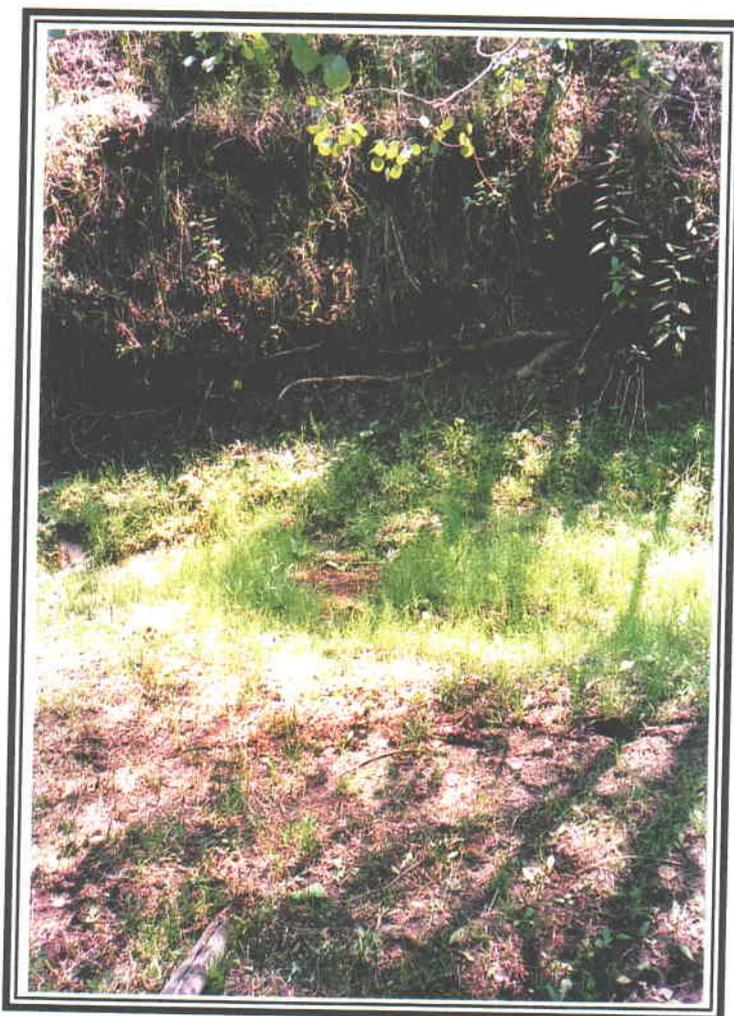
Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-09		Left	6.0	<i>Equisetum arvense/Agrostis stolonifera</i>
		Right	2.0	<i>Ranunculus cymbalaria/Equisetum arvense</i>
		Channel	1.0	Water

RE-09: Cover by community types in Box Canyons (July 2006)

USDA Forest Service Protocol (1992)

UPLAND VEGETATION	Cover (ft)
<i>Populus tremuloides</i>	20.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera/Equisetum arvensis</i>	6.00
<i>Ranunculus cymbalaria/Equisetum arvensis</i>	2.00
TOTAL COVER (Upland Species)	20.00
TOTAL COVER (Riparian Species)	8.00
BAREGROUND	0.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	1.00
Moss	0.00
TOTAL COVER	29.00

PHOTOGRAPHIC DOCUMENTATION



R-09

RIPARIAN COMPLEX DATA SHEET

July 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-11

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 18 - 21, 2006

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: 350 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)
<i>Picea pungens</i>	<i>Rosa woodsii</i>	<i>Epilobium angustifolium</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Equisetum arvense</i>	<i>Juncus longistylis</i>
<i>Salix sp.</i>		<i>Ranunculus cymbalaria</i>	<i>Juncus arcticus</i>
			<i>Poa secunda</i>

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: 30
- % bank length unvegetated, stable: 0
- % bank length vegetated, unstable: 0
- % bank length unvegetated, unstable: 70

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.
- 3) Right stake was missing. For transect, we measured from aspen tree (see photo) with blue flag.
- 4) Left side ave. 60% veg [ave. of two sides therefore 30% (see Bank Condition above)].
- 5) Left side had more riparian vegetation and less upland.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-11		Left	9.0	<i>Equisetum arvense</i> / <i>Agrostis stolonifera</i> / <i>Salix</i> sp.
		Right	0	
		Channel	0.5 2.0	Water Bareground

R-11: Cover by community types in Box Canyons (July 2006)

USDA Forest Service Protocol (1992)

UPLAND VEGETATION

Picea pungens/*Poa secunda*

Cover (ft)

15.50

RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

Agrostis stolonifera

5.00

Equisetum arvensis

4.00

TOTAL COVER (Upland Species)

15.50

TOTAL COVER (Riparian Species)

9.00

BAREGROUND

2.00

ROCK

0.00

WATER/MUD/DRY CHANNEL

0.50

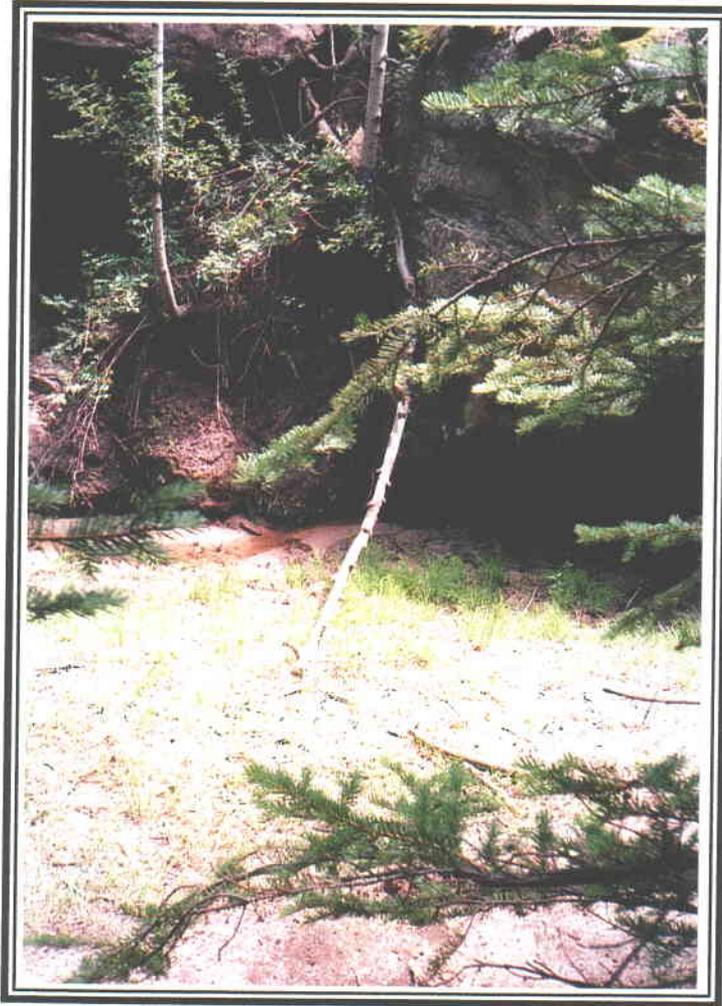
Moss

0.00

TOTAL COVER

27.00

PHOTOGRAPHIC DOCUMENTATION



R-11

RIPARIAN COMPLEX DATA SHEET

July 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-13

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 18 - 21, 2006

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: NNW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: $\sim 2^{\circ}$

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)
<i>Picea pungens</i>	<i>Potentilla fruticosa</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Juniperus communis</i>	<i>Cirsium sp.</i>	<i>Carex nebraskensis</i>
<i>Salix lucida</i>		<i>Ranunculus cymbalaria</i>	<i>Carex lanuginosa</i>
<i>Salix sp.</i>			<i>Juncus longistylis</i>
			<i>Bromus carinatus</i>
			<i>Elymus trachycaulus</i>
			<i>Juncus arcticus</i>
			<i>Poa fendleriana</i>

POOL ATTRIBUTES

- % area in pools: 100
- % 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: 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) There was a discrepancy with total transect length between 1999 (42 ft.) and Oct 2003 (45 ft.); July 2004, October 2004, July 2005, October 2005, July 2006 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) About 15 ft of right side riparian community (Redtop/Wiregrass) was influenced by tributary on that side but this influence appeared less this sample period for unknown reasons.
- 5) The upper banks were wetland and probably influenced by the stream water.
- 6) Redtop was increasing and dominated the riparian community as a whole.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

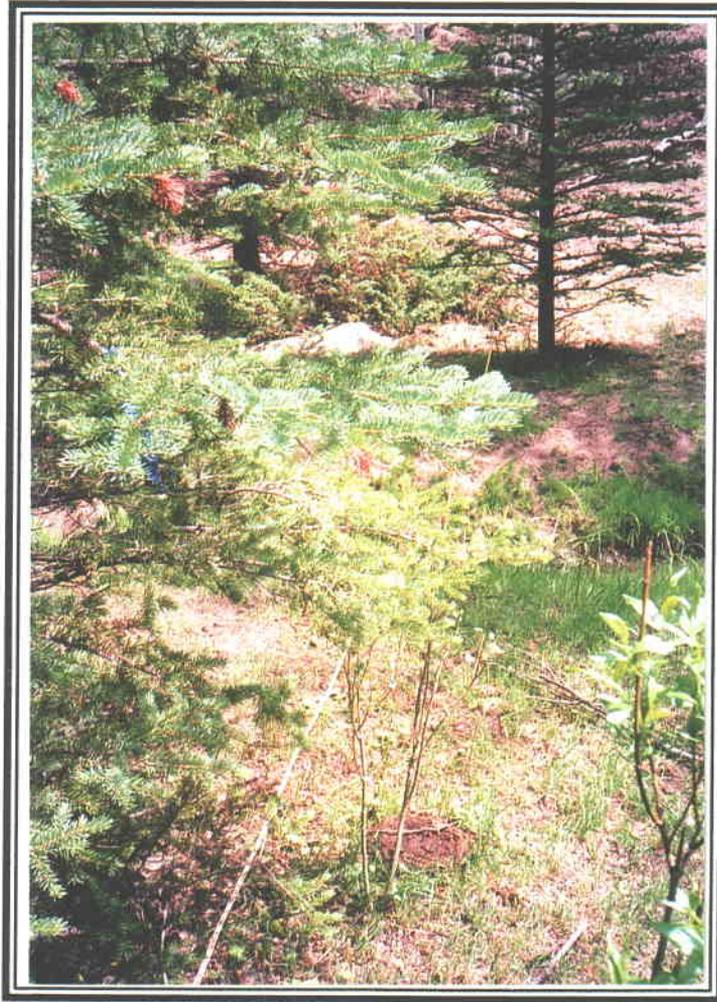
Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-13		Left	10.5	<i>Agrostis stolonifera</i> / <i>Carex nebraskensis</i> / <i>Equisetum arvense</i>
		Right	7.5	<i>Agrostis stolonifera</i> / <i>Salix lutea</i> / <i>Carex lanuginosa</i>
		Channel	1.0	Bareground

R-13: Cover by community types in Box Canyons (July 2006)

USDA Forest Service Protocol (1992)

UPLAND VEGETATION	Cover (ft)
<i>Picea pungens</i>	27.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera</i>	6.00
<i>Equisetum arvensis</i>	4.50
<i>Equisetum arvensis</i> / <i>Carex nebrascensis</i>	7.50
TOTAL COVER (Upland Species)	27.00
TOTAL COVER (Riparian Species)	18.00
BAREGROUND	1.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	0.00
Moss	0.00
TOTAL COVER	46.00

PHOTOGRAPHIC DOCUMENTATION



R-13

RIPARIAN COMPLEX DATA SHEET
July 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-15

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 18 - 21, 2006

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: 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)
<i>Picea pungens</i>	<i>Juniperus communis</i>	<i>Aster sp.</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Symphoricarpos oreophilus</i>	<i>Equisetum arvense</i>	
<i>Cornus stolonifera</i>	<i>Salix lutea</i>	<i>Epilobium angustifolium</i>	

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°): 40
 % bank length gently sloping (>135°): 5
 % bank length with overhanging vegetation: 20

BANK CONDITION

% bank length vegetated, stable: 30
 % bank length unvegetated, stable: 30
 % bank length vegetated, unstable: 5
 % bank length unvegetated, unstable: 35

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; since that time it has been consistent (26 ft.).

- 4) Photo from 1999 was from a different place (stake number indicated I was in the correct location in the following sample years).
- 5) Right side had patchy vegetation and sandy bareground areas. Left side had virtually no riparian vegetation.
- 6) The severe flooding mentioned in the East Fork did not seem to impact the Main Fork as much. Perhaps it rained more in the Main Fork, or maybe it is the nature of the two channels due to other environmental influences.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

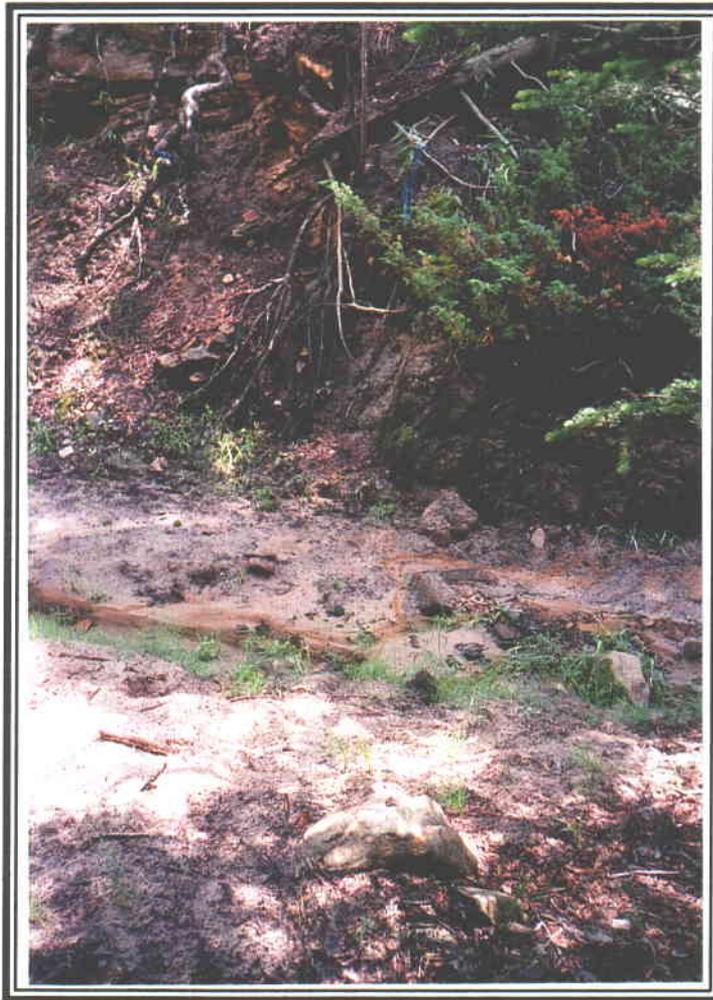
Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-15		Left	3.0	<i>Equisetum arvense</i>
		Right	0	
		Channel	0.5 4.5	Water Bareground/Rock

R-15: Cover by community types in Box Canyons (July 2006)

USDA Forest Service Protocol (1992)

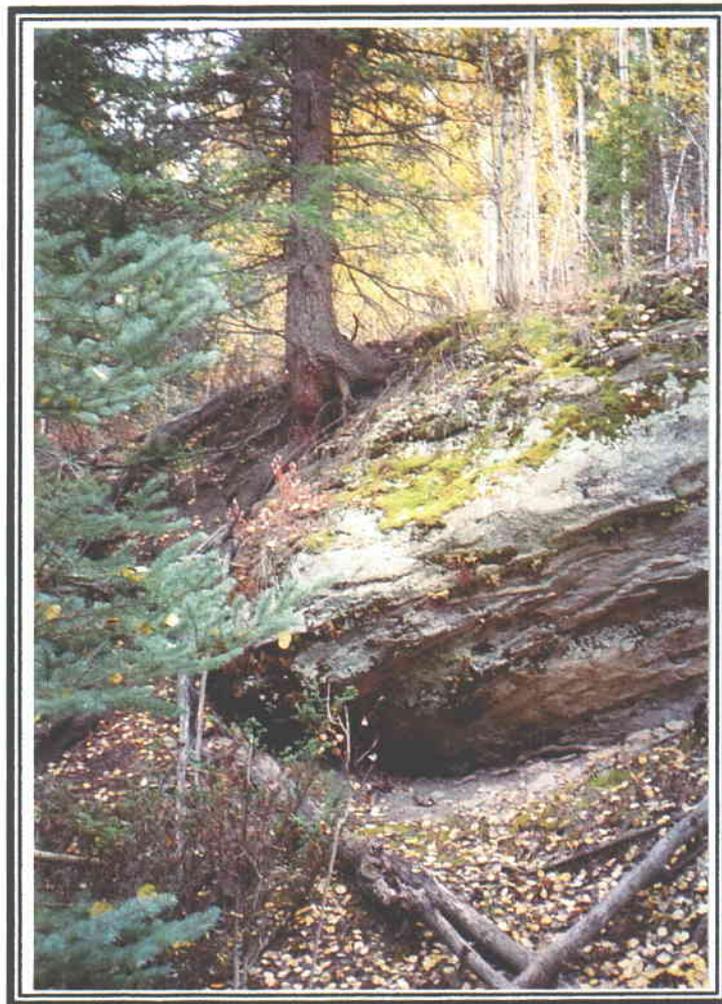
UPLAND VEGETATION	Cover (ft)
<i>Populus tremuloides/Picea pungens</i>	18.00
<i>Populus tremuloides/Rosa woodsii</i>	
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Equisetum arvensis</i>	3.00
TOTAL COVER (Upland Species)	18.00
TOTAL COVER (Riparian Species)	3.00
BAREGROUND	4.50
ROCK	0.00
WATER/MUD/DRY CHANNEL	0.50
Moss	0.00
TOTAL COVER	26.00

PHOTOGRAPHIC DOCUMENTATION



R-15

**Riparian Plant Communities
in the
East Fork of Box Canyon
October 2006**



**A Vegetation Monitoring Study
for the
SUFCA Mine:
October 2006**

Prepared by

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March 2007



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EFB-10 (RE-09)	48
EFB-11	53
EFB-S1	57
EFB-S2 (EFB-12)	61
EFB-S3 (EFB-13)	65
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RE-11	73
RE-12	77
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R-07	85
R-09	89
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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 2006**. Data were also recorded in several locations in the Main Fork of Box Canyon. These data sets may be used for controls in 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 *seventh* 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 *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 *third* sample period was in October 2004 (*Riparian Plant Communities in the East Fork of Box Canyon: October 2004*). The *fourth* sample period was in July 2005 (*Plant Communities in the East Fork of Box Canyon: July 2005*). The *fifth* sample period was in October 2005 (*Plant Communities in the East Fork of Box Canyon: October 2005*). The past sample period was the sixth of the sampling regime (*Plant Communities in the East Fork of Box Canyon: July 2006*).

INTRODUCTION

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.

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 (DOGMA), 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 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 began to be recorded again 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.

With the one exception to the protocol modification mentioned above, the parameters for all sample stations in the 2003, 2004, 2005, and 2006 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 and perpendicular to it. 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 October 2006 in the East Fork and Main Fork of Box Canyon have been included in this report. USDA Forest Service protocol and other methods were employed to monitor the riparian areas. These methods utilized the 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 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 October 2003, July 2004, October 2004, July 2005, October 2005, July 2006, and October 2006. Five of these previous 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 later. 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.

As suggested in an earlier monitoring report (July 2005 sample period), upon scrutinizing the data sets for each sample period, the *Community Cover and Green Line methods appear to be more conducive to noting changes in the riparian plant communities*.

Monitoring reports from previous sample periods suggested that many of the riparian communities in the East Fork of Box Canyon decreased, especially between October 2003 and July 2004. At other sample locations, little change was noticed. Other than the spring areas which will be discussed separately, the trend since that time was for the communities to stabilize and then begin to somewhat increase over time. Since no two sample areas appeared to have the exact same results over time, changes are best considered on a sample station-by-station basis. Accordingly, data has been plotted on charts to illustrate changes over time from the October 2003 through the October 2006 sample periods (Figs. 1-4).

To make it easier to review, the data in the figures were summarized in groups. In Fig. 1, the data show the results over time for sample stations EFB-1 through EFB-8 using the *Green Line* method. In Fig. 2, the data were also grouped by site numbers, or RE-09 through RE-13, using the *Community Type Cover* method. Data summaries shown in Fig. 1 and Fig. 2 are comparable to each because both show the cover width of the riparian communities (or Green Lines) in feet over time. (NOTE: Some of the sample stations have two identification names; refer to the RESULTS section above for cross-referencing).

As can be observed in Fig. 1, most of the riparian plant communities have remained relatively stable over time for these sites, much like the control sites in the Main Fork of Box Canyon (Fig. 4). Fig. 2 results are somewhat more dynamic. In these sample locations, results suggest a decline in most riparian plant communities cover from October 2003 to July 2004. From July

2004 to October 2005 the communities seem to stabilize, then begin to increase where some reach or exceed their original (2003) values. However, from October 2005 to October 2006 there was an obvious decrease in the width of the riparian communities at most sites [especially the well-defined (non-meadow) channels].

Abrupt decreases in the riparian community widths in July 2006 and October 2006 were, in all probability, due the flooding that occurred in the area – especially on July 19th when it rained 1.22 inches within an hour time period. This event was witnessed by the author; severe flooding occurred in the East Fork of Box Canyon where severe bank erosion was also witnessed. Also worth noting was the storm event that occurred October 6, 2006 when it rained 1.79 inches that day. Because the October sampling was completed before that day, impacts to the riparian communities by that storm are unknown by the author at this time.

Fig. 3 shows the results of the sample stations that were placed in spring areas. In all but one of the sites, there was a rather abrupt decrease in the riparian communities especially between October 2003 and July 2004. The trend for the spring areas was to increase after that, but not to the values recorded in October 2003. One spring area (EFB-S1) maintained its riparian community for the first three sample periods, then decreased and remain consistent. Reasons for maintenance of its riparian species may be due to its location when compared to the other spring areas – it was located much lower on the hillside and much closer to the main channel. This spring appeared to retain more water than the upper elevation springs that nearly dried up completely sometime during the spring of 2004.

Although many of the environmental conditions in the Main Fork of Box Canyon were not exactly the same as those in the East Fork, they were the best “control” conditions found at the time the studies began in 2003 (plus, there was the benefit of earlier recorded 1999 data). Consequently, five of these sites were also monitored during the same periods as the East Fork monitoring regime. Fig. 4 shows that, although these plant communities have somewhat fluctuated over time, they have remained relatively constant from October 2003 through October 2006.

**FIG. 1: EAST FORK BOX CANYON
GREEN LINE METHOD**

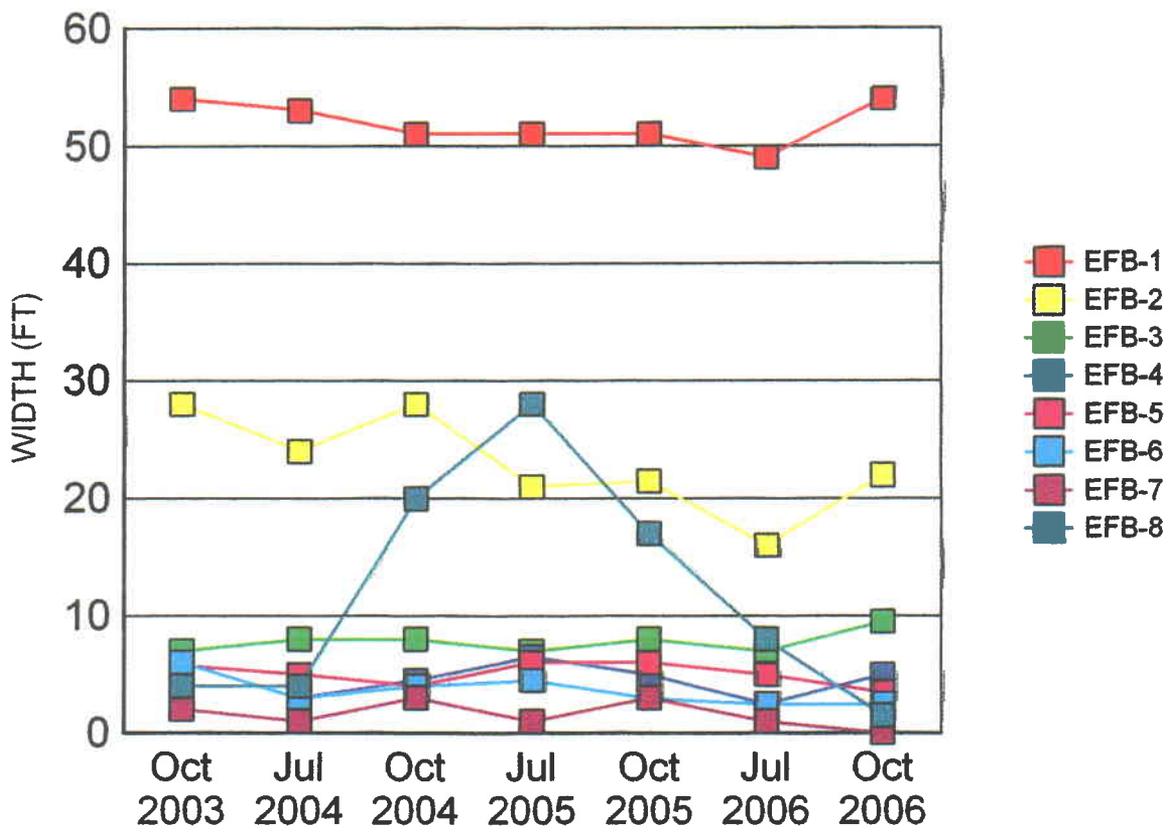


FIG 2: EAST FORK BOX CANYON

RIPARIAN COMMUNITY METHOD

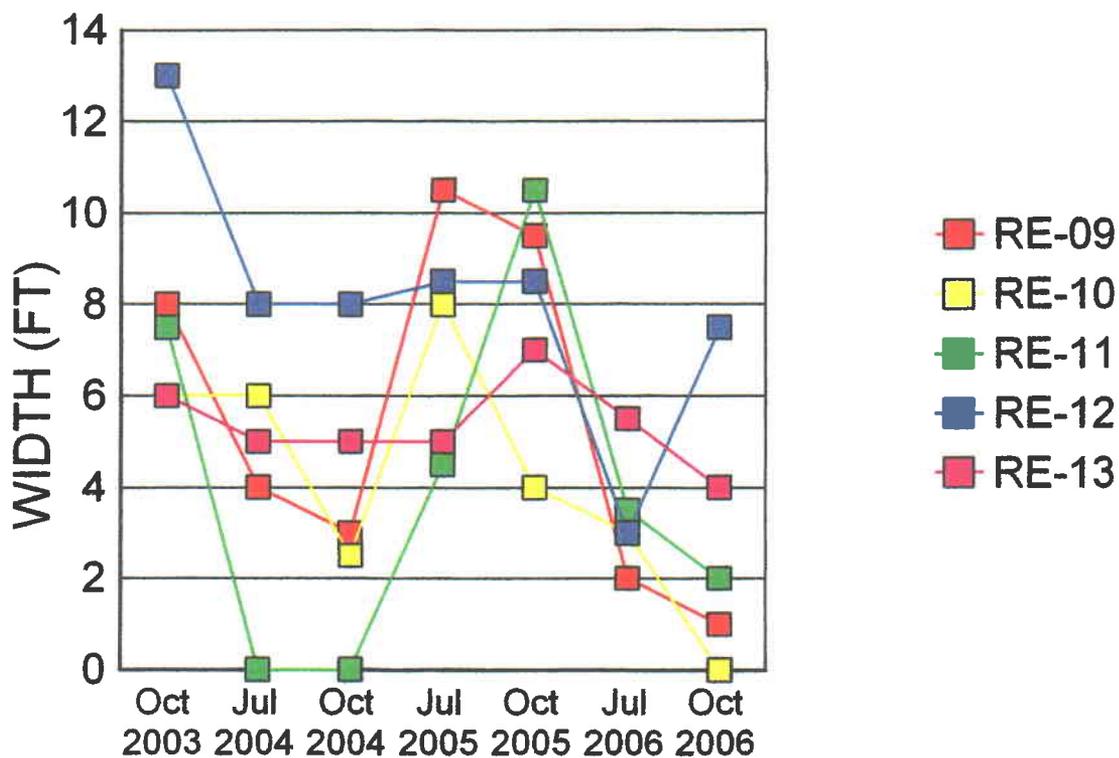


FIG 3: EAST FORK BOX CANYON
GREEN LINE METHOD (SPRINGS)

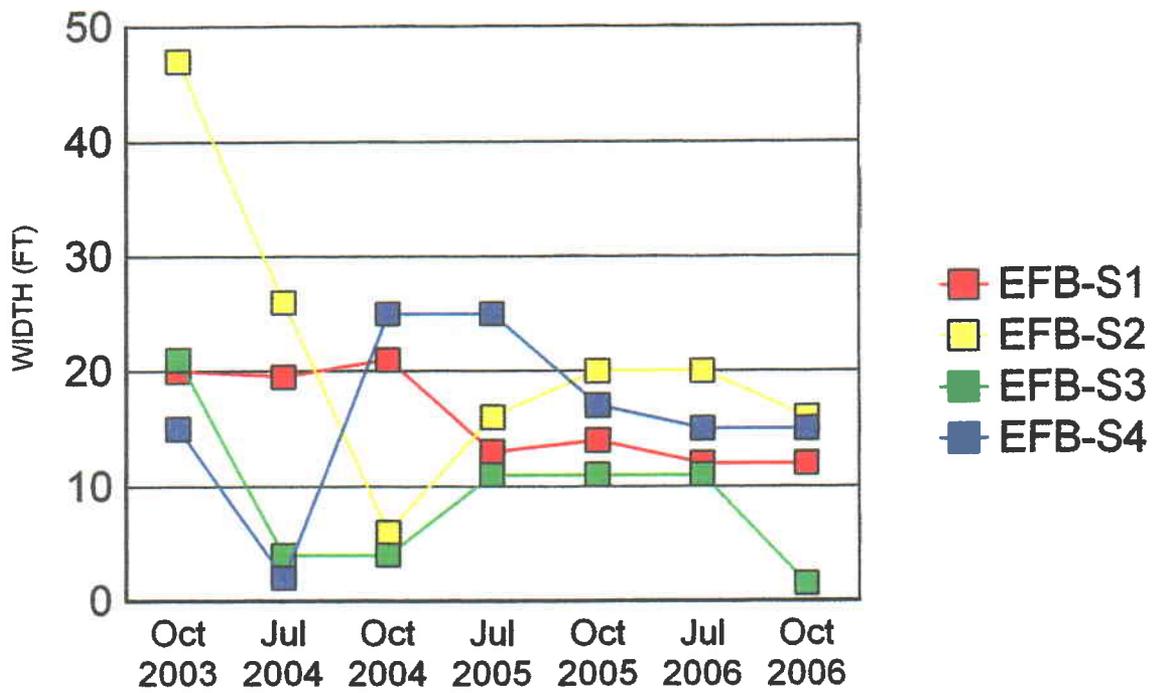
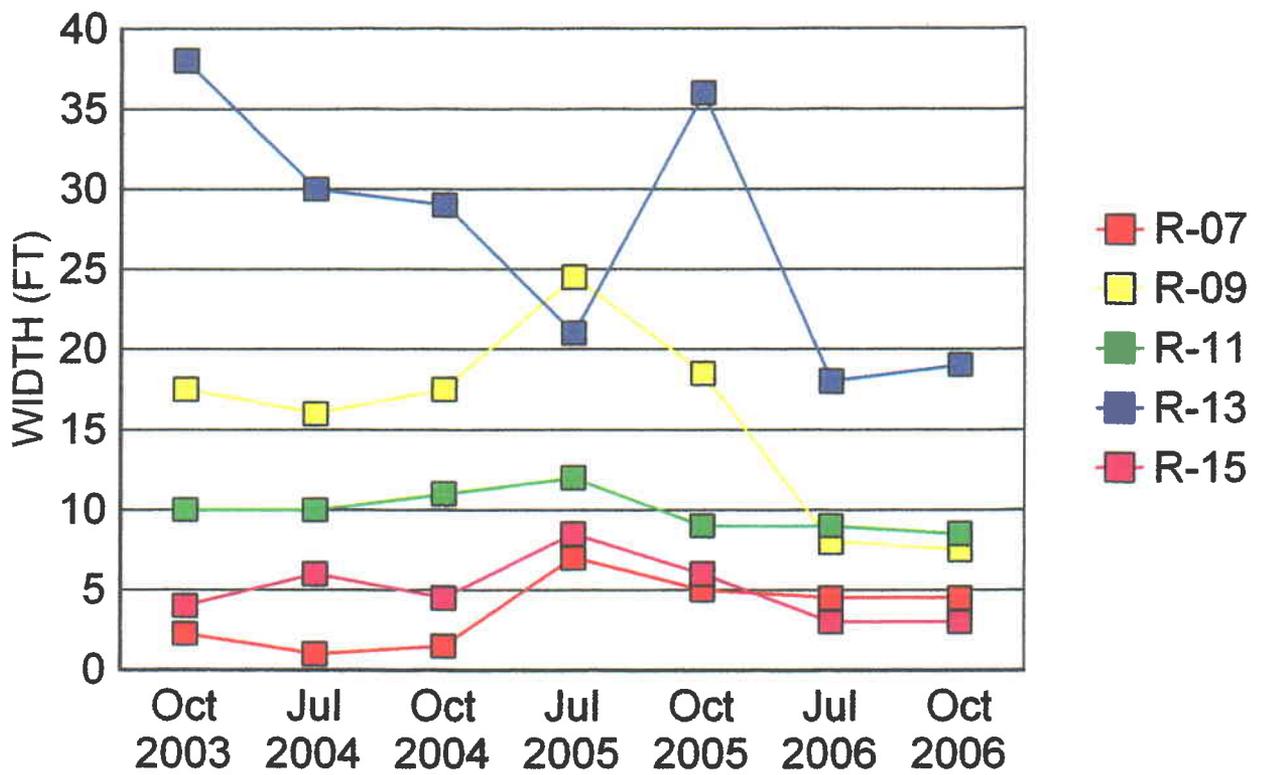


FIG 4: MAIN FORK BOX CANYON RIPARIAN COMMUNITY METHODS



RIPARIAN COMPLEX DATA SHEET
October 2006

CLIENT: Canyon Fuel Company

COMPLEX: Number EFB-1

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 2 - 5, 2006

OBSERVER(S): P.D. Collins

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: West

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: $\sim 1^\circ$

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

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 950 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)
<i>Picea pungens</i>	<i>Potentilla fruticosa</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Rosa woodsii</i>		<i>Carex hoodii</i>
			<i>Carex lanuginosa</i>
			<i>Juncus longistylis</i>
			<i>Juncus arcticus</i>
			<i>Poa pratensis</i>

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: 65 (more if I included moss)

% bank length unvegetated, stable: 35

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

BANK STABILITY: *relatively 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 water present.
- 2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 29 ft. transect on left side; 30 ft. transect on right side (59 ft; includes uplands).
- 3) Cattle use not apparent.

DATA SUMMARIES

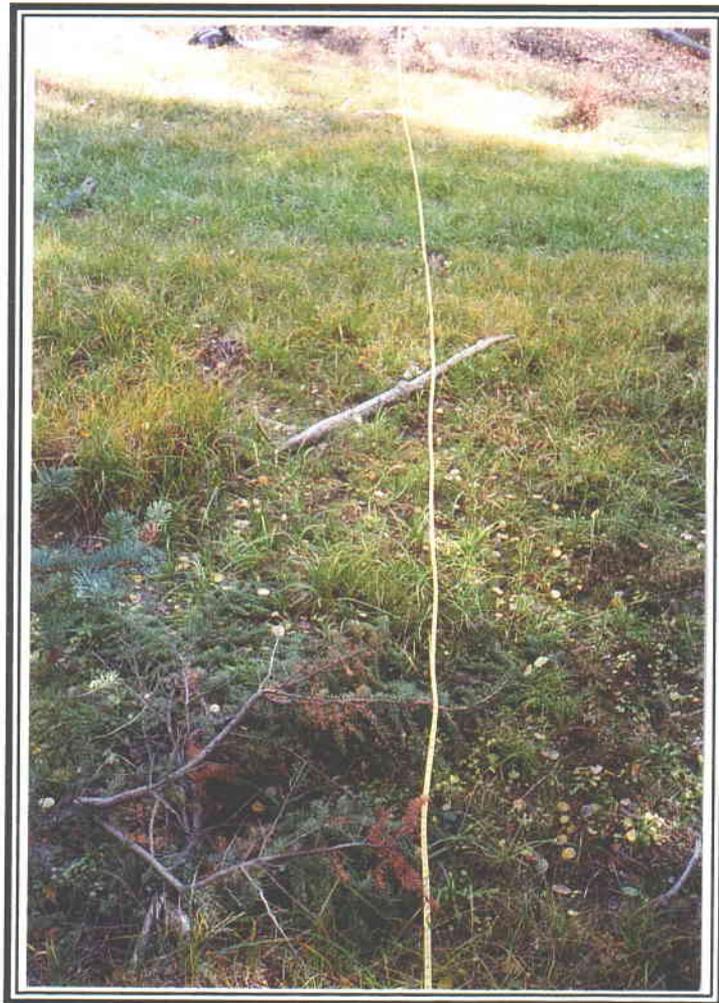
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-1		Left	27.0	<i>Carex lanuginosa/Agrostis stolonifera</i>
		Right	27.0	<i>Carex lanuginosa/Agrostis stolonifera</i>
		Channel	n/a	Dry (no standing water)
		Upland	5.0	

EFB-1: Cover using point quadrats (October 2006).

<u>COVER BY SPECIES</u>	<u>PERCENT</u>
TREES & SHRUBS	
FORBS	
GRASSES	
<i>Agrostis stolonifera</i>	26.32
<i>Carex lanuginosa</i>	47.37
<i>Juncus longistylis</i>	5.26
TOTAL COVER	
LIVING COVER (vascular)	78.95
WATER	0.00
MOSS	0.00
LITTER	15.79
B/G	5.26
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-1

RIPARIAN COMPLEX DATA SHEET
October 2006

CLIENT: Canyon Fuel Company

COMPLEX: Number EFB-2

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 2 - 5, 2006

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°

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

APPARENT FORAGE TREND: more or less stable

ESTIMATED FORAGE PRODUCTION: 300 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)
<i>Pinus ponderosa</i>	<i>Artemisia tridentata</i>	<i>Achillea millefolium</i>	<i>Juncus arcticus</i>
<i>Populus tremuloides</i>	<i>Potentilla fruticosa</i>	<i>Aster sp.</i>	<i>Agrostis stolonifera</i>
		<i>Equisetum arvense</i>	<i>Poa pratensis</i>
		<i>Potentilla sp.</i>	<i>Poa secunda</i>
		<i>Taraxacum officinale</i>	

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: 65

% bank length unvegetated, stable: 35

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

BANK STABILITY: *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. Site was dry. Less bareground than previous samples.
- 2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 25 ft. transect on right side (48 ft; includes uplands).
- 3) Sign of grazing by cattle not observed.
- 4) Meadow was dominated by Kentucky bluegrass; wetter areas of site were dominated by redtop and wiregrass.
- 5) Site seemed wetter this period compared to last sample period.

DATA SUMMARIES

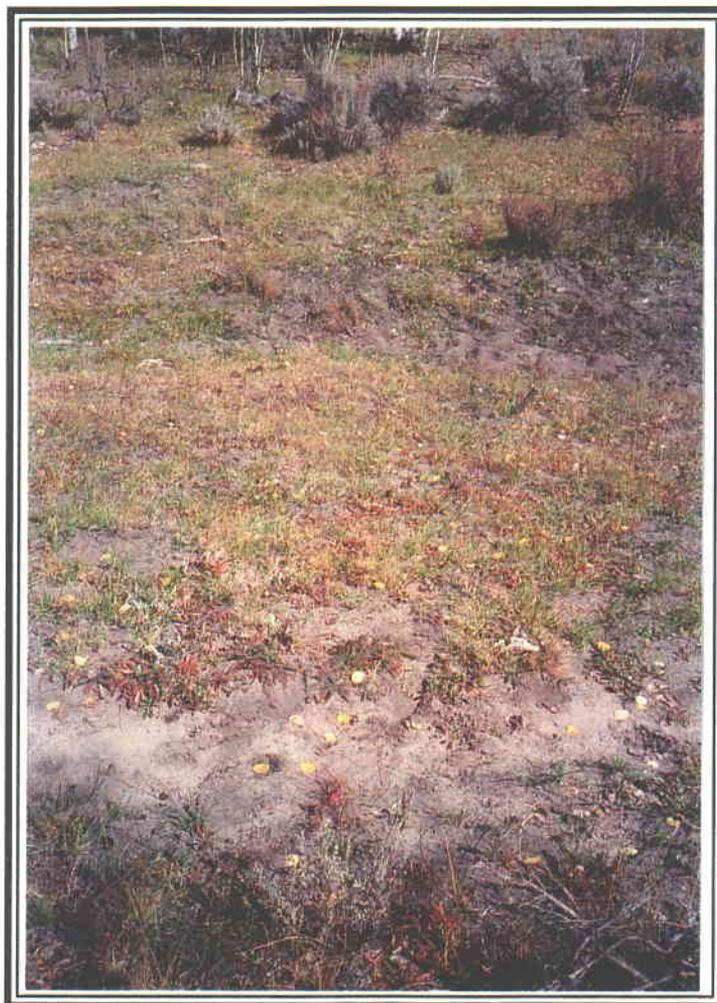
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-2		Left	11.0	<i>Agrostis stolonifera/Juncus arcticus</i>
		Right	11.0	<i>Agrostis stolonifera/Juncus arcticus</i>
		Channel	3.0	Dry

EFB-2: Cover using point quadrats (October 2006).

COVER BY SPECIES	PERCENT
TREES & SHRUBS	
FORBS	
<i>Achillea millefolium</i>	6.25
<i>Equisetum arvense</i>	6.25
<i>Potentilla</i> sp.	6.25
GRASSES	
<i>Agrostis stolonifera</i>	25.00
<i>Poa pratensis</i>	6.25
TOTAL COVER	
LIVING COVER (vascular)	50.00
STREAM	0.00
MOSS	0.00
LITTER	31.25
B/G	18.75
ROCK	
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-2

RIPARIAN COMPLEX DATA SHEET
October 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-3

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 2 - 5, 2006

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)
<i>Pinus ponderosa</i>	<i>Artemisia tridentata</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Lepidium latifolia</i>	<i>Carex lanuginosa</i>
		<i>Taraxacum officinale</i>	<i>Juncus arcticus</i>
		<i>Eriogonum sp.</i>	<i>Poa fendleriana</i>
		<i>Lupinus sp.</i>	<i>Poa pratensis</i>

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: 80
- % bank length unvegetated, stable: 20
- % 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. (48 ft; includes uplands).
- 2) Little or no grazing by cattle this year.
- 3) Dry, no water.
- 4) Cattle trail in left side of riparian vegetation may influence green line measurements.

5) Riparian spp. seemed to be more prevalent above what I measured as the stream riparian plants. In other words, they were on side areas and maybe were uninfluenced by bottomland riparian water zone.

DATA SUMMARIES

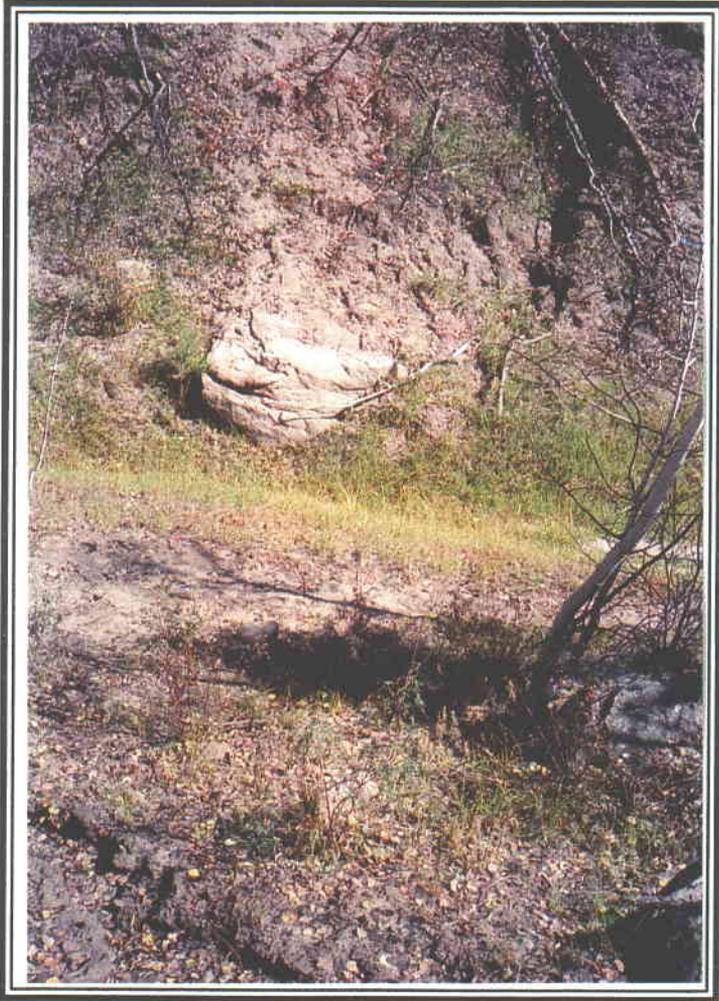
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-3		Left	5.0	<i>Agrostis stolonifera</i> / <i>Carex lanuginosa</i>
		Right	4.5	<i>Agrostis stolonifera</i> / <i>Carex lanuginosa</i>
		Channel	n/a	Dry

EFB-3: Cover using point quadrats (October 2006).

COVER BY SPECIES	PERCENT
TREES & SHRUBS	
FORBS	
<i>Eriogonum sp.</i>	6.25
<i>Lupinus sp.</i>	6.25
GRASSES	
<i>Agrostis stolonifera</i>	12.50
<i>Carex lanuginosa</i>	6.25
<i>Poa pratensis</i>	6.25
TOTAL COVER	
LIVING COVER (vascular)	37.50
WATER	0.00
MOSS	0.00
LITTER	31.25
B/G	31.25
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-3

RIPARIAN COMPLEX DATA SHEET
October 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-4

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 2 - 5, 2006

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: seral (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)
<i>Picea pungens</i>	<i>Artemisia tridentata</i>	<i>Antennaria sp.</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Chrysothamnus nauseosus</i>	<i>Equisetum arvense</i>	<i>Juncus arcticus</i>
<i>Pinus ponderosa</i>	<i>Potentilla fruticosa</i>		<i>Poa fendleriana</i>
	<i>Rosa woodsii</i>		<i>Poa pratensis</i>

POOL ATTRIBUTES

% area in pools: Dry
 % 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: 15
 % bank length unvegetated, stable: 25
 % bank length vegetated, unstable: 10
 % 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) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side (48 ft; includes uplands).
- 2) No water was present at site, but in July 2006 a very large storm event forced me to leave the site. Flooding and severe bank erosion occurred at that time. I later learned the storm event was >1.20" of precipitation in less than 1 hour. Also, another 1.79" evidently occurred one day after I left the area.
- 3) No grazing by cattle was evident this sample period.

4) Site only had small riparian area, it appeared dryer.

DATA SUMMARIES

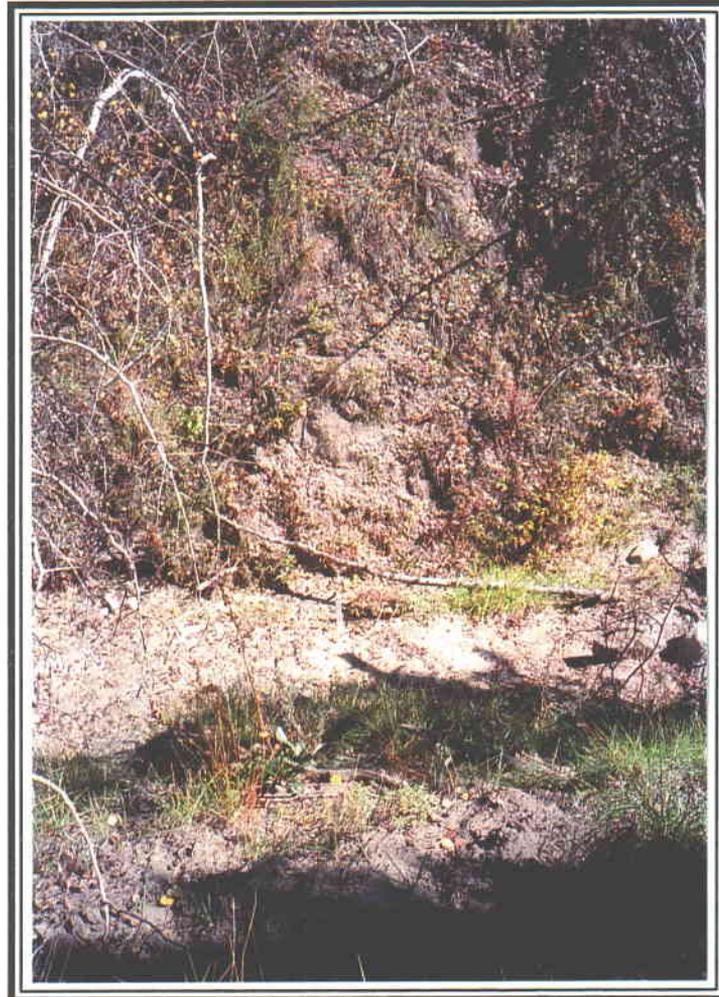
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-4		Left	2.0	<i>Agrostis stolonifera</i>
		Right	3.0	<i>Agrostis stolonifera</i>
		Channel	2.0	Dry

EFB-4: Cover using point quadrats (October 2006).

COVER BY SPECIES	PERCENT
TREES & SHRUBS	
FORBS	
<i>Equisetum arvense</i>	6.25
GRASSES	
<i>Poa pratensis</i>	25.00
<i>Poa secunda</i>	18.75
TOTAL COVER	
LIVING COVER (vascular)	50.00
WATER	0.00
MOSS	0.00
LITTER	31.25
B/G	18.75
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-4

RIPARIAN COMPLEX DATA SHEET
October 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-5

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 2 - 5, 2006

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: 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)
<i>Picea pungens</i>	<i>Artemisia tridentata</i>	<i>Antennaria sp.</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Potentilla fruticosa</i>	<i>Lupinus sp.</i>	<i>Poa fendleriana</i>
<i>Pinus ponderosa</i>	<i>Rosa woodsii</i>		<i>P. secunda</i>
	<i>Salix exigua</i>		<i>P. pratensis</i>
	<i>Symphoricarpos oreophilus</i>		<i>Stipa hymenoides</i>
			<i>Bouteloua gracilis</i>

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: *20*
- % bank length unvegetated, stable: *0*
- % bank length vegetated, unstable: *20*
- % bank length unvegetated, unstable: *60*

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 sandy and unstable.
- 2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side (48 ft; includes uplands).
- 3) No water in channel in this location; seemed to be okay from recent flooding.

4) No cattle grazing signs observed this sample period.

DATA SUMMARIES

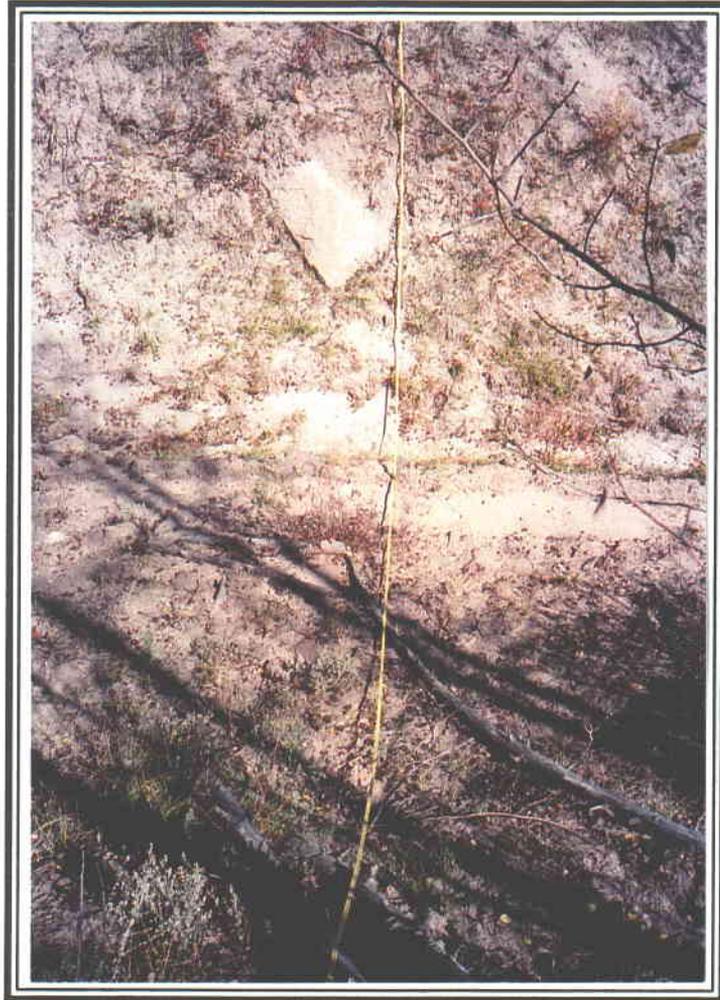
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-5		Left	3.0	<i>Agrostis stolonifera</i>
		Right	0.5	<i>Agrostis stolonifera</i>
		Channel	2.0	Dry

EFB-5 Cover using point quadrats (October 2006).

COVER BY SPECIES	PERCENT
TREES & SHRUBS	
<i>Populus tremuloides</i>	6.25
FORBS	
<i>Lupinus sp.</i>	6.25
GRASSES	
<i>Poa secunda</i>	18.75
<i>Bouteloua gracilis</i>	6.25
TOTAL COVER	
LIVING COVER (vascular)	37.50
WATER	0.00
MOSS	0.00
LITTER	18.75
B/G	43.75
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-5

RIPARIAN COMPLEX DATA SHEET
October 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-6

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 2 - 5, 2006

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 Sai 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: 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)
<i>Picea pungens</i>	<i>Amelanchier utahensis</i>	<i>Taraxacum officinale</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Potentilla fruticosa</i>	<i>Antennaria sp.</i>	<i>Bromus carinatus</i>
<i>Pinus ponderosa</i>	<i>Symphoricarpos oreophilus</i>	<i>Aster sp.</i>	<i>Juncus arcticus</i>
<i>Populus fremontii</i>	<i>Artemisia tridentata</i>	<i>Gilia aggregata</i>	<i>Poa fendleriana</i>
		<i>Artemisia ludoviciana</i>	<i>Elymus trachycaulus</i>
			<i>Poa pratensis</i>

POOL ATTRIBUTES

- % area in pools: *Dry*
- % 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°): *(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 (48 ft; includes uplands).
- 3) Little or no grazing by cattle this year. Dry this October, but water was just downstream

50' - 70' from this location.

- 4) Cattle trail was on some of the riparian community and could affect results.
- 5) Area had much debris (some large) from previous 2 days of flooding.

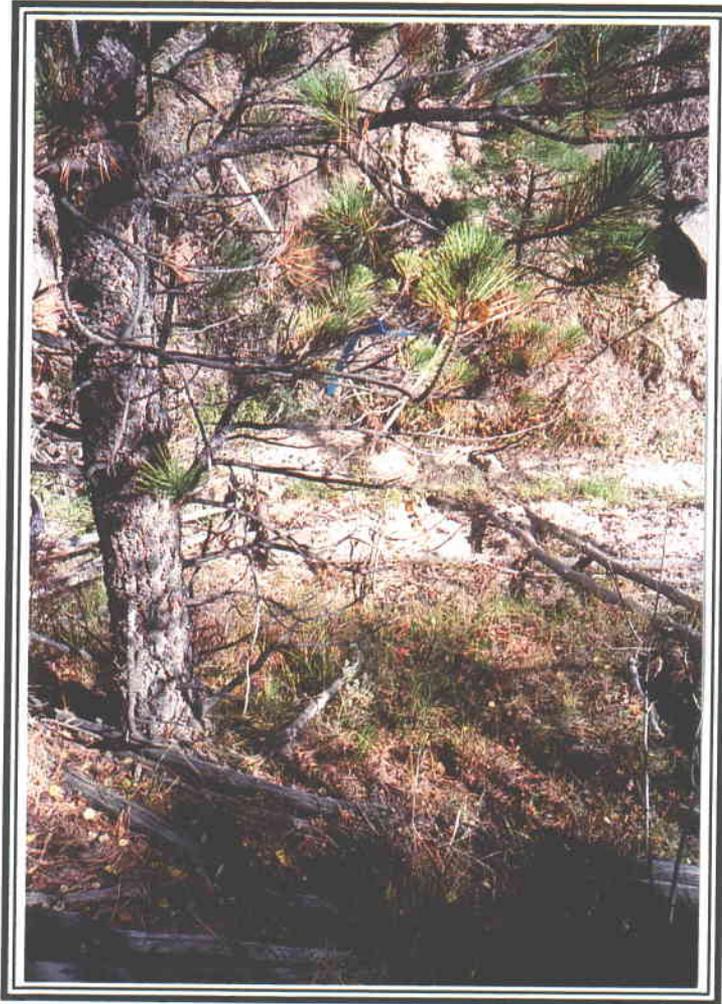
DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-6		Left	1.5	<i>Agrostis stolonifera</i>
		Right	1.0	<i>Agrostis stolonifera</i>
		Channel	2.5	Dry

EFB-6 Cover using point quadrats (October 2006).	
COVER BY SPECIES	PERCENT
TREES & SHRUBS	
FORBS	
GRASSES	
<i>Agrostis stolonifera</i>	12.50
<i>Poa fendleriana</i>	37.50
TOTAL COVER	
LIVING COVER (vascular)	50.00
WATER	0.00
MOSS	0.00
LITTER	18.75
B/G	31.25
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-6

RIPARIAN COMPLEX DATA SHEET
October 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-7

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 2 - 5, 2006

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: Unstable

ESTIMATED FORAGE PRODUCTION: 0 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)
<i>Picea pungens</i>	<i>Juniperus communis</i>	<i>Aster sp.</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Symphoricarpos oreophilus</i>	<i>Artemisia dracunculus</i>	<i>Poa fendleriana</i>
<i>Rosa woodsii</i>		<i>Castilleja sp.</i>	

POOL ATTRIBUTES

% area in pools: 70

% 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: 0

% bank length unvegetated, stable: 0

% bank length vegetated, unstable: 20 (above riparian zone)

% 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. Water was present.
- 2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side (48 ft; includes uplands).
- 3) Very unstable upper banks (above bankfull).
- 4) Little or no grazing in this area.
- 5) Much side slope movement on right and left sides.

6) This area seemed to have much more bedrock exposed with less soil on left bank along the riparian channel. There was not much of a riparian zone at this site. This may be the result of the July flooding (> 1.2" in less than 1 hr.) I observed. Evidently another large storm event occurred after this sample period (1.79" October 2006).

7) Aspens have fallen since early data (see photos).

DATA SUMMARIES

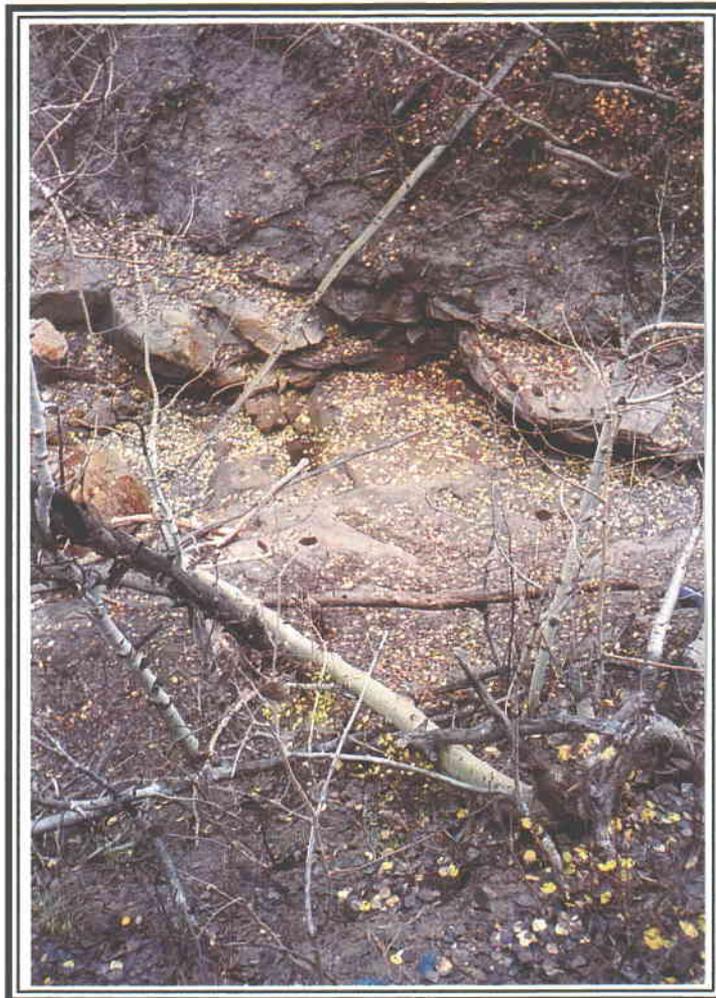
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-7		Left	0	<i>Agrostis stolonifera</i>
		Right	0	<i>Agrostis stolonifera</i>
		Channel Water	2.0 1.0	Rock Water

EFB-7 Cover using point quadrats (October 2006).

COVER BY SPECIES	PERCENT
TREES & SHRUBS	
<i>Symphoricarpos oreophilus</i>	6.25
FORBS	
GRASSES	
<i>Poa secunda</i>	6.25
TOTAL COVER	
LIVING COVER (vascular)	12.50
WATER	6.25
MOSS	6.25
LITTER	37.50
B/G	25.00
ROCK	12.50
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-7

RIPARIAN COMPLEX DATA SHEET
October 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-8

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 2 - 5, 2006

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: Unstable

ESTIMATED FORAGE PRODUCTION: 0 lbs./ac. in riparian zone.

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)
<i>Picea pungens</i>	<i>Symphoricarpos oreophilus</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Achillea millefolium</i>	<i>Poa fendleriana</i>
<i>Pinus ponderosa</i>		<i>Penstemon sp.</i>	<i>P. pratensis</i>
		<i>Antennaria sp.</i>	
		<i>Equisetum arvensis</i>	
		<i>Potentilla sp.</i>	

POOL ATTRIBUTES

- % area in pools: 70
- % 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: 10

BANK CONDITION (riparian channel)

- % bank length vegetated, stable: 0
- % bank length unvegetated, stable: 50
- % 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) Beginning to see more blue spruce and less ponderosa pine in uplands in this area.
- 2) Quantitative Methods: This is a difficult area to monitor because there is a spring on the right side with water flowing from it. The information above is for the main channel.

- 3) For the point quads, the transect crossed the spring community too (transect total = 56 ft; channel erosion increased length from 54 ft). *I did not count the "island" between the two as riparian* (but I may have previously). For both separate data, see the Green Line method below.
- 4) There was severe flooding impacts here in the July 2006 flood. The bank was down cut ± 3 ft lower than the previous elevations. There was a great deal of debris in the area. The small green conifer in the area was downed (compare photographs with previous sample periods). Riparian communities have been impacted by the flooding.
- 5) No cattle sign this year.

DATA SUMMARIES

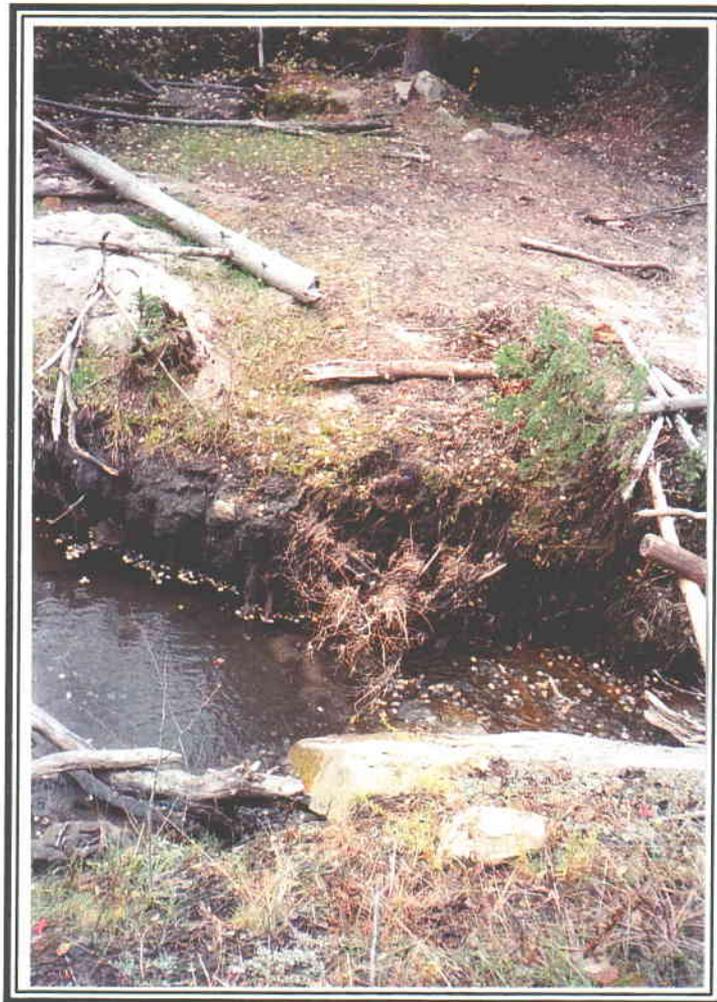
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-8 Main Channel		Left	0	<i>Equisetum arvensis/Agrostis stolonifera</i>
		Right	0	<i>Equisetum arvense</i>
		Channel	6.0	Water
EFB-8 Spring Channel		Left	1.0	<i>Agrostis stolonifera</i>
		Right	0.5	<i>Agrostis stolonifera</i>
		Channel	4.5 0.5	Mud Water

EFB-8 Cover using point quadrats (October 2006).

COVER BY SPECIES	PERCENT
TREES & SHRUBS	
FORBS	
<i>Equisetum arvense</i>	5.56
<i>Antennaria</i> sp.	5.56
GRASSES	
<i>Agrostis stolonifera</i>	11.11
<i>Poa pratensis</i>	16.67
TOTAL COVER	
LIVING COVER (vascular)	38.89
WATER	11.11
MOSS	0.00
LITTER	27.78
B/G	22.22
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-8

RIPARIAN COMPLEX DATA SHEET

October 2006

CLIENT: Canyon Fuel Company

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

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 2 - 5, 2006

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)
<i>Picea pungens</i>	<i>Ribes sp.</i>	<i>Equisetum arvensis</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Rosa woodsii</i>		
<i>Salix amygdaloides</i>	<i>Symphoricarpos oreophilus</i>		

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°): 0

% bank length with overhanging vegetation: 35

BANK CONDITION

% bank length vegetated, stable: 0

% bank length unvegetated, stable: 50

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 50

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 and left sides.

2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals for 38 ft.(see below).

In addition, the USDA Forest Service Protocol for Level III was employed by measuring the plant communities using the line intercept method.

3) Little or no grazing by cattle this year.

4) For point quadrats we had different transect lengths: Oct 03 (50 ft), July 04 (50 ft), Oct 04 (32 ft or 38 ft); July 05 (38 ft); Oct 05 (38 ft); July 06 (38'); Oct 2006 (38'). 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. Note that comparisons of these data can be confusing because pt. quad transects were sometimes different than line transects.

4) Floods mentioned earlier basically eliminated the riparian zone at this site.

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	0	<i>Equisetum arvense</i>
		Right	0	<i>Equisetum arvense</i>
		Channel	2.0 6.0	Water Rock

RE-10 (EFB-9) Cover using point quadrats (October 2006).

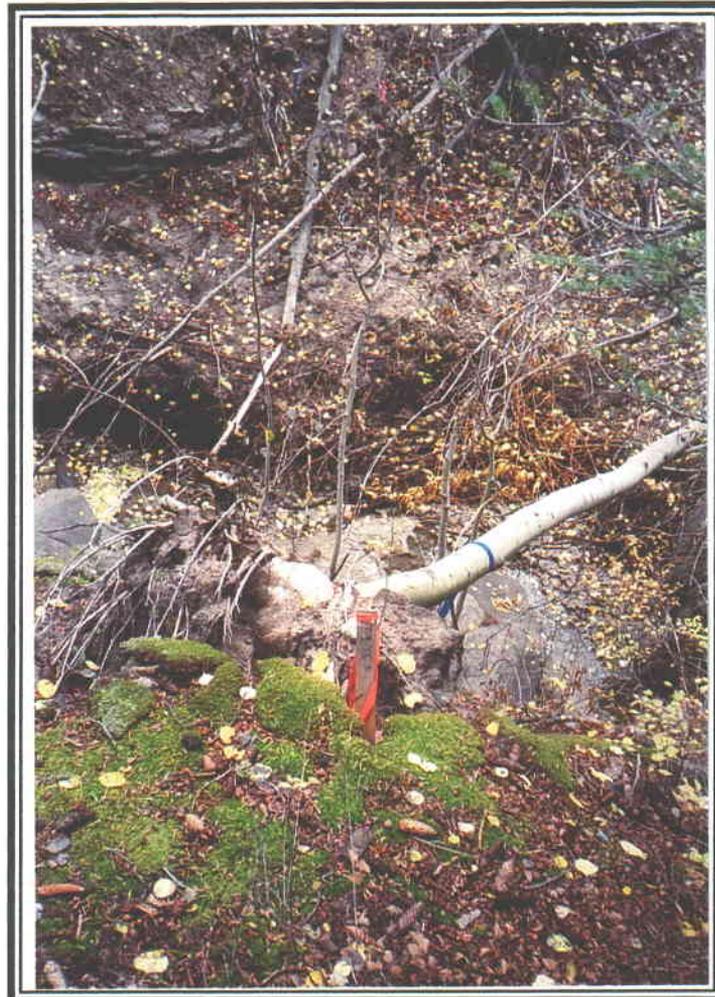
COVER BY SPECIES	PERCENT
TREES & SHRUBS	
<i>Rosa woodsii</i>	8.33
FORBS	
GRASSES	
TOTAL COVER	
LIVING COVER (vascular)	8.33
WATER	8.33
MOSS	16.67
LITTER	50.00
B/G	8.33
ROCK	8.33
TOTAL	100.00

RE-10 (EFB-9): Cover by community types in Box Canyons (October 2006)

USDA Forest Service Protocol (1992)

	Cover (ft)
UPLAND VEGETATION	
<i>Populus tremuloides/Rosa woodsii</i>	21.00
	9.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
TOTAL COVER (Upland Species)	30.00
TOTAL COVER (Riparian Species)	0.00
BAREGROUND	6.00
ROCK	2.00
WATER/MUD/DRY CHANNEL	0.00
Moss	0.00
TOTAL COVER	38.00

PHOTOGRAPHIC DOCUMENTATION



EFB-9 (RE-10)

RIPARIAN COMPLEX DATA SHEET
October 2006

CLIENT: Canyon Fuel Company

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

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 2 - 5, 2006

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk

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: 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)
<i>Picea pungens</i>	<i>Salix sp.</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Rosa woodsii</i>	<i>Geranium richardsonii</i>	<i>Poa pratensis</i>
<i>Betula occidentalis</i>		<i>Equisetum arvense</i>	
		<i>Epilobium angustifolium</i>	

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°): 10

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

% bank length with overhanging vegetation: 10

BANK CONDITION

% bank length vegetated, stable: 10

% bank length unvegetated, stable: 30

% bank length vegetated, unstable: 10

% 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) Just beginning to see river birch in this area.
- 2) Quantitative Methods: There were two transect lines here because of the older (1999) study. One was 28 ft (from 1999) and one was 36 ft (team study). For point quadrats for Oct 2005, we sampled at 3 ft. intervals for the 28 ft transect line. I also sampled on 36 ft line (left in raw data). Regarding the two pt. quad transect lines (28 ft and 36 ft) for July 2006 and Oct 2006, I sampled the 36 ft line.
 In addition, the USDA Forest Service Protocol for Level III was employed by measuring the plant communities using the line intercept method (I used a 36 ft transect line in Oct 2005 and July 2006 which was *not consistent with July 2005*).
- 3) Right 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) Water at site; waterfall is above this station.
- 5) Photo taken from left side.
- 6) Negligible grazing by cattle this year.
- 7) There was lots of bareground that I counted in the upland community.
- 8) There were some small live blue spruce trees downed due to flooding and side slope movement.
- 9) Very unstable area at this time.
- 10) I believe this is one of D. Shiozawa's macroinvertebrate sampling sites.
- 11) The aforementioned flooding in July 2006 took most of the riparian zone on the left side.
- 12) There was also a fallen live conifer due to the instability and flooding.

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	0	<i>Equisetum arvense</i> / <i>Geranium richardsonii</i>
		Right	1.0	<i>Equisetum arvense</i>
		Channel	2.5 3.5	Water Rock

RE-9 (EFB-10) Cover using point quadrats (October 2006).

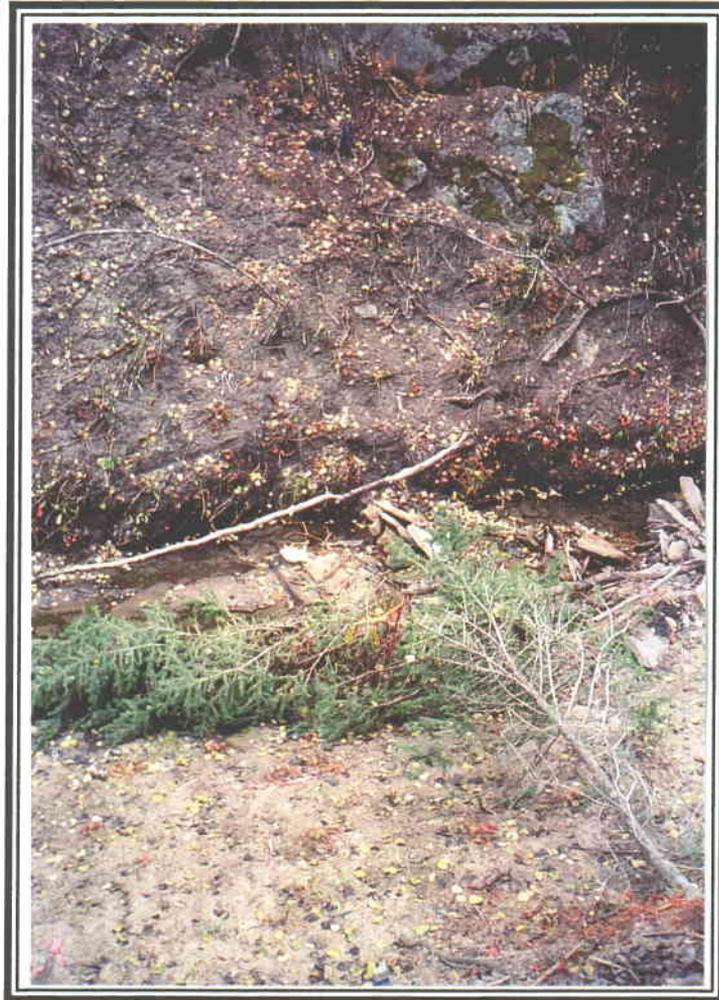
COVER BY SPECIES	PERCENT
TREES & SHRUBS	
<i>Symphoricarpos oreophilus</i>	
FORBS	
<i>Geranium richardsonii</i>	8.33
GRASSES	
<i>Poa pratensis</i>	8.33
TOTAL COVER	
LIVING COVER (vascular)	16.67
WATER	8.33
MOSS	0.00
LITTER	50.00
B/G	16.67
ROCK	8.33
TOTAL	100.00

RE-09 (EFB-10): Cover by community types in Box Canyons (October 2006)

USDA Forest Service Protocol (1992)

	Cover (ft)
UPLAND VEGETATION	
<i>Populus tremuloides/Festuca ovina</i>	29.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Equisetum arvensis</i>	1.00
TOTAL COVER (Upland Species)	29.00
TOTAL COVER (Riparian Species)	1.00
BAREGROUND	3.50
ROCK	2.50
WATER/MUD/DRY CHANNEL	0.00
Moss	0.00
TOTAL COVER	36.00

PHOTOGRAPHIC DOCUMENTATION



EFB-10 (RE-09)

RIPARIAN COMPLEX DATA SHEET

October 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-11

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 2 - 5, 2006

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: Unstable due to recent flooding.

APPARENT FORAGE TREND: Decreasing

ESTIMATED FORAGE PRODUCTION: 50 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)
<i>Picea pungens</i>	<i>Pachystima myrsinites</i>	<i>Cirsium sp.</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Symphoricarpos oreophilus</i>	<i>Geranium richardsonii</i>	<i>Juncus longistylis</i>
<i>Salix sp.</i>		<i>Equisetum arvense</i>	<i>Poa fendleriana</i>
<i>Cornus sericea</i>			
<i>Betula occidentalis</i>			

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°): 0
- % bank length with overhanging vegetation: 20

BANK CONDITION

- % bank length vegetated, stable: 20
- % bank length unvegetated, stable: 40
- % bank length vegetated, unstable: 0
- % bank length unvegetated, unstable: 40

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 on a 45 ft transect line.
- 3) Little or no grazing by cattle this year.
- 4) Flood took down or pushed over mature trees just upstream from sample site including river birch, willow, and dogwood (photographs taken for files in July and October 2006).
- 5) Most of the riparian zone was eliminated from flooding.

DATA SUMMARIES

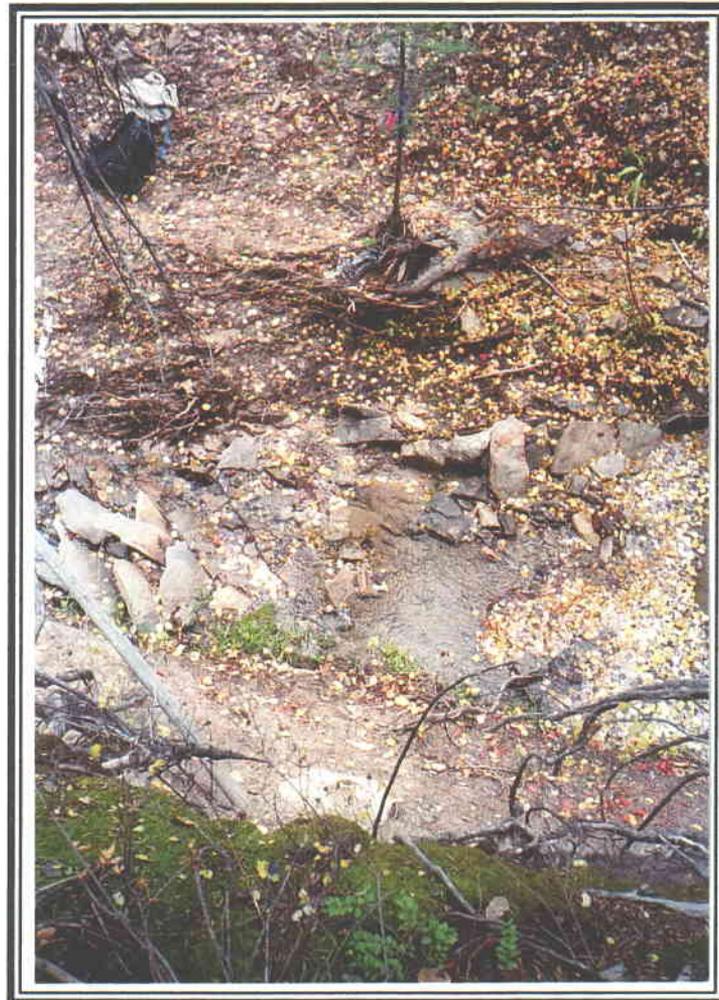
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-11		Left	1.0	<i>Agrostis stolonifera</i>
		Right	0.5	<i>Agrostis stolonifera</i>
		Channel	3.0 1.5	Water Rock

EFB-11 Cover using point quadrats (October 2006).

COVER BY SPECIES	PERCENT
TREES & SHRUBS	
FORBS	
<i>Equisetum arvense</i>	6.67
<i>Cirsium sp.</i>	6.67
GRASSES	
TOTAL COVER	
LIVING COVER (vascular)	13.33
WATER	13.33
MOSS	6.67
LITTER	20.00
B/G	33.33
ROCK	13.33
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-11

RIPARIAN COMPLEX DATA SHEET

October 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-S1

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 2 - 5, 2006

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: unstable

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)
<i>Picea pungens</i>	<i>Salix sp.</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Symphoricarpos oreophilus</i>	<i>Ranunculus cymbalaria</i>	<i>Carex lanuginosa</i>
	<i>Rosa woodsii</i>	<i>Aster sp.</i>	<i>Elymus trachycaulus</i>
	<i>Lonicera involucrata</i>	<i>Geranium richardsonii</i>	<i>Juncus arcticus</i>
	<i>Betula occidentalis</i>		<i>Bromus carinatus</i>

POOL ATTRIBUTES

% area in pools: 5

% 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) Original stakes were gone. I put blue flagging and made a 37 ft transect line in Oct 2005; I used this line for July and Oct 2006.
- 4) Water in spring seems to be increasing compared to the last two sample periods. The spring water seems to have increased its flow.

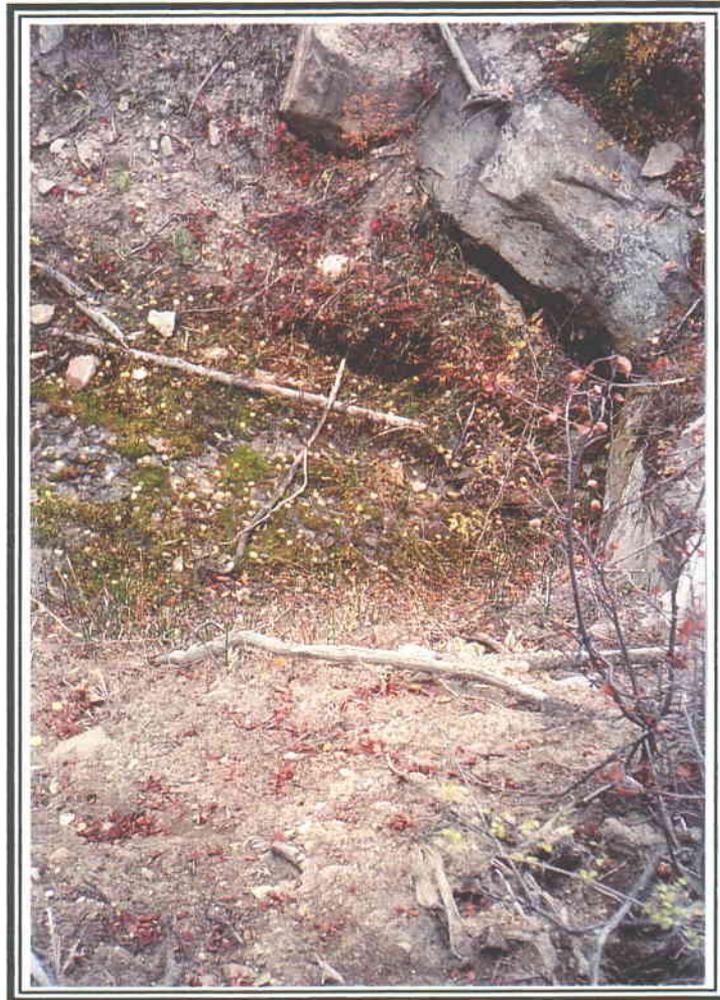
DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-S1		Left	6.0	<i>Equisetum arvense/Ranunculus cymbalaria</i>
		Right	6.0	<i>Equisetum arvense/Ranunculus cymbalaria</i>
		Channel	1.0	Water

EFB-S1: Cover by community types in Box Canyons (October 2006)		EFB-S1
USDA Forest Service Protocol (1992)		Cover (ft)
UPLAND VEGETATION		
<i>Bromus carinatus</i>		17
<i>Elymus trachycaulus</i>		7
RIPARIAN VEGETATION		
<u>Dominant Woody Species</u>		
<u>Dominant Herbaceous Species</u>		
<i>Ranunculus cymbalaria/Equisetum arvensis</i>		12
TOTAL COVER (Upland Species)		24.00
TOTAL COVER (Riparian Species)		12.00
BAREGROUND		0
ROCK		0
WATER/MUD/DRY CHANNEL		1
Moss		0
TOTAL COVER		37.00

PHOTOGRAPHIC DOCUMENTATION



EFB-S1

RIPARIAN COMPLEX DATA SHEET

October 2006

CLIENT: Canyon Fuel Company

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

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 2 - 5, 2006

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: Not climax, unstable.

APPARENT FORAGE TREND: Unstable

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)
<i>Picea pungens</i>	<i>Juniperus communis</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Equisetum arvense</i>	<i>Carex lanuginosa</i>
<i>Lonicera involucrata</i>		<i>Geranium richardsonii</i>	
<i>Betula occidentalis</i>			

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: 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) 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 again this sample period (Oct. 2005) 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. Yet some riparian or mesic species may be increasing such as horsetail, sedge and geranium.

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 on the previous transect line. Green Line: Also measured on transects.

4) As mentioned last sample period, some seeps may be beginning to form again below the sample area because riparian species such as *Carex lanuginosa*, *Salix* sp., *Betula occidentalis*, and *Rosa woodsii* were beginning to show up, but the historical spring still remains mostly absent.

5) I am not sure what to think about this site; there are riparian spp. present that seem to be increasing, but it definitely does not look like the spring has returned. There must be water close to the surface however.

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	2.0	<i>Equisetum arvense</i>
		Right	14.0	<i>Geranium richardsonii</i> / <i>Equisetum arvense</i> / <i>Carex lanuginosa</i>
		Channel	n/a	

EFB-S2: Cover by community types in Box Canyons (October 2006) **EFB-S2**

USDA Forest Service Protocol (1992)

Cover (ft)

UPLAND VEGETATION

Populus tremuloides/*Festuca ovina* 38

RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

Carex lanuginosa 6

Geranium richardsonii/*Equisetum arvense* 8

Ranunculus cymbalaria/*Equisetum arvensis* 2

TOTAL COVER (Upland Species) 38.00

TOTAL COVER (Riparian Species) 16.00

BAREGROUND 0

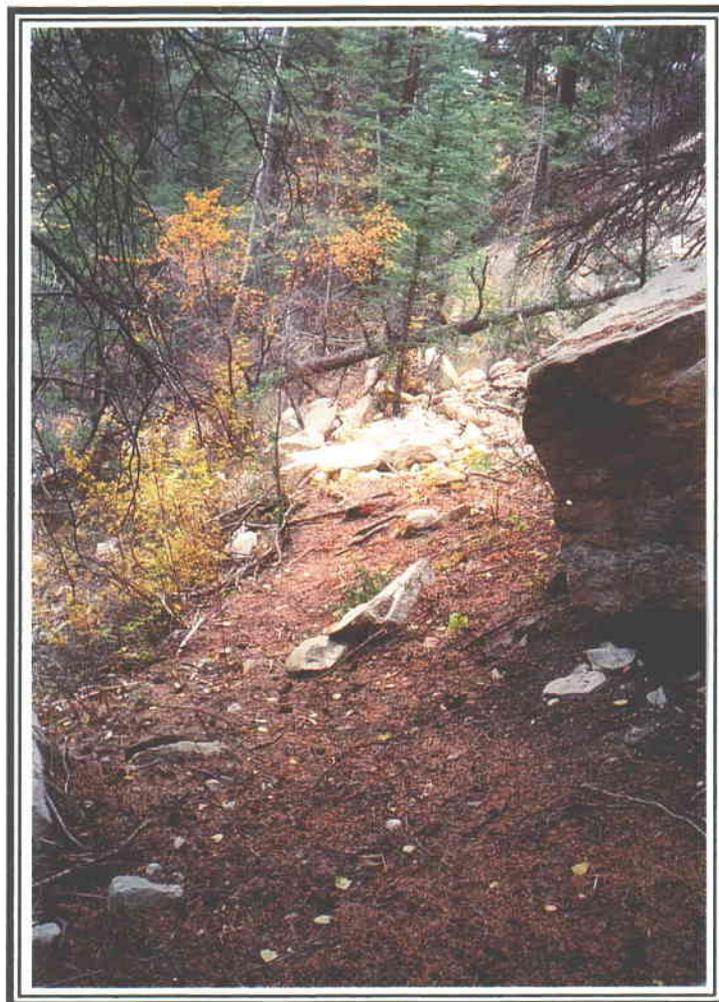
ROCK 25

WATER/MUD/DRY CHANNEL 0

Moss 0

TOTAL COVER 79.00

PHOTOGRAPHIC DOCUMENTATION



EFB-S2 (EFB-12)

RIPARIAN COMPLEX DATA SHEET
October 2006

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: October 2 - 5, 2006

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: Unstable, no longer considered "climax".

APPARENT FORAGE TREND: unstable

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)
<i>Picea pungens</i>	<i>Symphoricarpos oreophilus</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Juniperus communis</i>	<i>Equisetum arvense</i>	<i>Elymus trachycaulus</i>
<i>Pinus ponderosa</i>	<i>Rosa woodsii</i>	<i>Geranium richardsonii</i>	
<i>Salix amygdaloides</i>			
<i>Cornus stolonifera</i>			

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 (North/South)

- % bank length vegetated, stable: 10/0
- % bank length unvegetated, stable: 90/100
- % 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 line stakes. I measured north S3 (30 ft) and south S3 (31 ft) separately.
- 3) This spring area has gone dry.
- 4) Riparian species present but decreased since October 2003; seem at equilibrium now.
- 5) There were wetland/riparian species (see Green Line data).
- 6) The understory in the area was mostly bareground.
- 7) Difficult to call data here.

DATA SUMMARIES

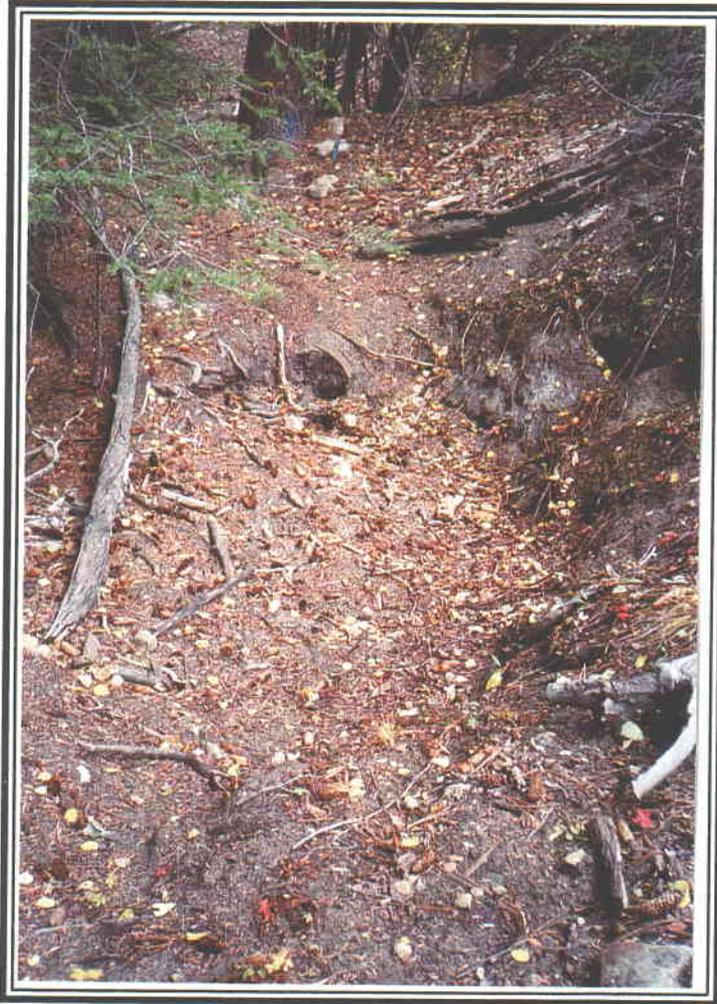
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-S3	EFB-13	North	1.5	<i>Agrostis stolonifera/Ranunculus cymbalaria</i>
		South	0.0	
		Channel	n/a	

EFB-S3 (EFB-13): Cover by community types in Box Canyons (October 2006)
USDA Forest Service Protocol (1992)

	Cover (ft)
UPLAND VEGETATION	
<i>Populus tremuloides/Rosa woodsii</i>	59.5
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera</i>	1.5
TOTAL COVER (Upland Species)	59.50
TOTAL COVER (Riparian Species)	1.50
BAREGROUND	0
ROCK	0
WATER/MUD/DRY CHANNEL	0
Moss	0
TOTAL COVER	61.00

PHOTOGRAPHIC DOCUMENTATION



EFB-S3 (EFB-13) South

RIPARIAN COMPLEX DATA SHEET

October 2006

CLIENT: Canyon Fuel Company

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

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 2 - 5, 2006

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: not climax.

APPARENT FORAGE TREND: Unstable

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)
<i>Picea pungens</i>	<i>Symphoricarpos oreophilus</i>	<i>Geranium richardsonii</i>	<i>Festuca ovina</i>
<i>Populus tremuloides</i>	<i>Potentilla fruticosa</i>	<i>Equisetum arvense</i>	
<i>Salix amygdaloides</i>	<i>Rosa woodsii</i>		

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: 30

% bank length vegetated, unstable: 10

% 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) Spring area. There was a seep here during the first sample period (Oct 2003). It was dry leaving bareground for last sample periods. Some riparian species remain. The entire transect area was dominated by horsetail with some redtop this period (maybe should be zero riparian due to spring water loss).

- 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'm not sure why the transect measures 19 ft this sample period, while other times it measured 25 ft. *Measured 19 ft this sample period.*

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	11.0	<i>Equisetum arvense</i>
		Right	4.0	<i>Equisetum arvense</i>
* (see notes above)		Channel	4.0	Bareground

EFB-S4 (EFB-14): Cover by community types in Box Canyons (October 2006)

USDA Forest Service Protocol (1992)

Cover (ft)

UPLAND VEGETATION

Populus tremuloides/Festuca ovina

4

RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

Equisetum arvensis

15

TOTAL COVER (Upland Species)

4.00

TOTAL COVER (Riparian Species)

15.00

BAREGROUND

0

ROCK

0

WATER/MUD/DRY CHANNEL

0

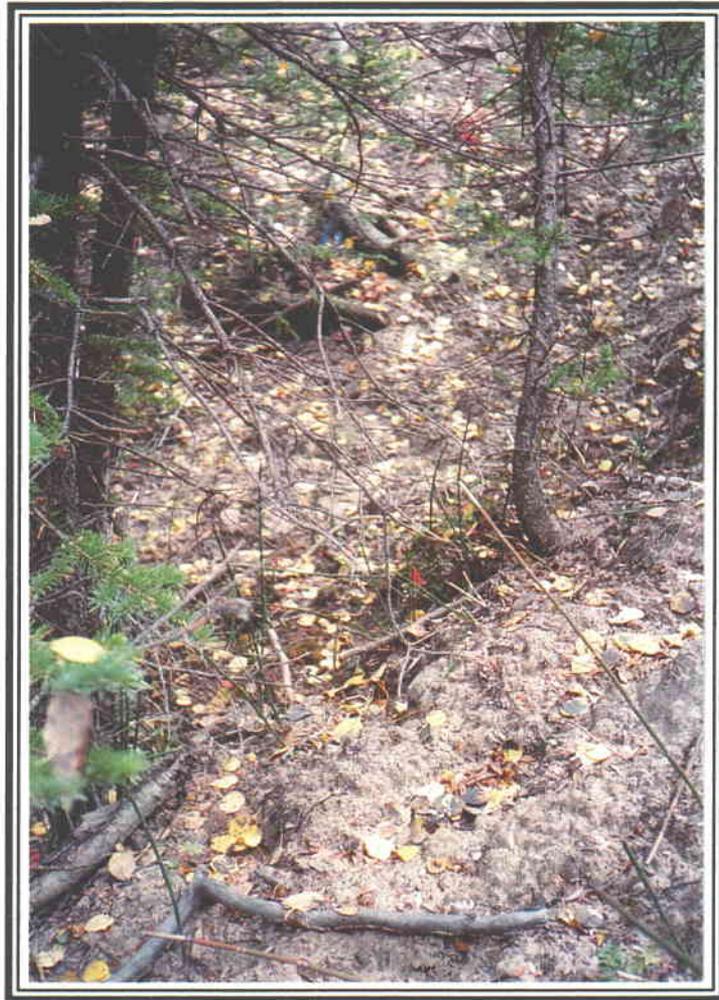
Moss

0

TOTAL COVER

19.00

PHOTOGRAPHIC DOCUMENTATION



EFB-S4 (EFB-14)

RIPARIAN COMPLEX DATA SHEET

October 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number RE-11

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 2 - 5, 2006

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: decreasing

ESTIMATED FORAGE PRODUCTION: 40 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)
<i>Picea pungens</i>	<i>Rosa woodsii</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>			<i>Juncus longistylis</i>

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°): 80

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

% bank length with overhanging vegetation: 30

BANK CONDITION

% bank length vegetated, stable: 10

% bank length unvegetated, stable: 40

% bank length vegetated, unstable: 10

% bank length unvegetated, unstable: 40

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 in Fall 2003. The Spring 2004 sample period revealed that a large spruce tree had fallen directly on 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 the fallen tree and extensive cattle disturbance in Spring and Fall 2004. Riparian species are returning here. In July 2005, right side had *Equisetum arvense* from hillside water. Last sample period (October 2005) had some *Equisetum arvense* and *Agrostis stolonifera*.

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) Recent flood (July 2006) evidence was obvious here with flattened vegetation (i.e. Wood's rose) and missing spruce tree. Also more erosional undercutting was observed. The upper left bank had more green vegetation that had moved downward (sloughing). Riparian spp. had low living cover.

4) I found early study stake under Wood's rose plants.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
RE-11		Left	1.0	<i>Agrostis stolonifera</i>
		Right	1.0	<i>Agrostis stolonifera</i>
		Channel	2.0 5.0	Water Rock

RE-11: Cover by community types in Box Canyons (October 2006)

USDA Forest Service Protocol (1992)

Cover (ft)

UPLAND VEGETATION

20.00

RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

Agrostis stolonifera

2.00

TOTAL COVER (Upland Species)

20.00

TOTAL COVER (Riparian Species)

2.00

BAREGROUND

5.00

ROCK

2.00

WATER/MUD/DRY CHANNEL

0.00

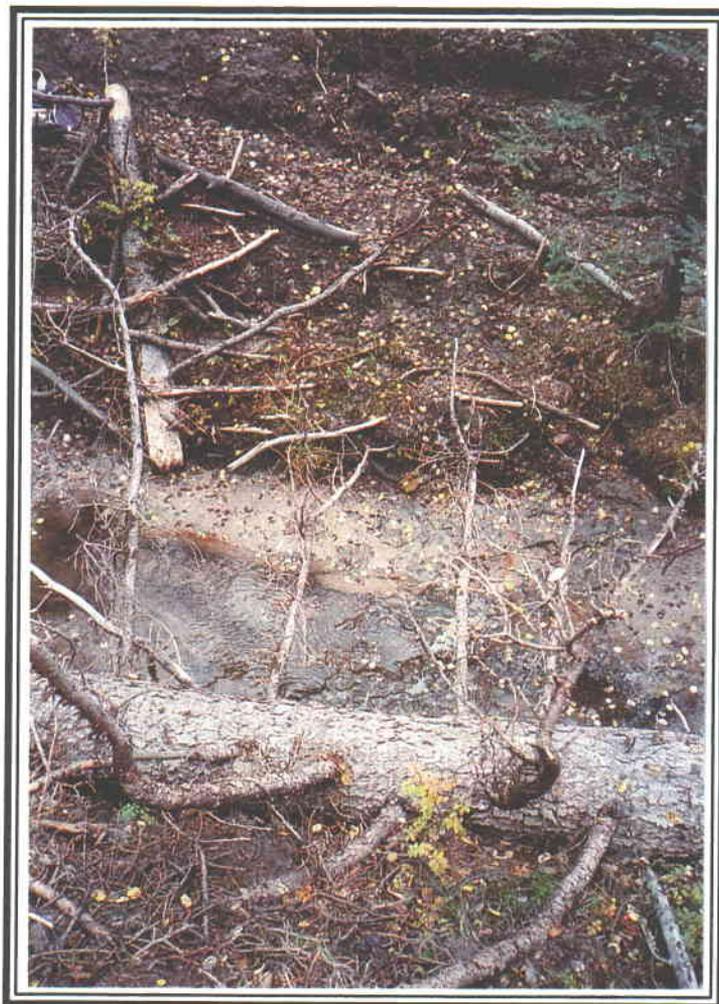
Moss

0.00

TOTAL COVER

29.00

PHOTOGRAPHIC DOCUMENTATION



RE-11

RIPARIAN COMPLEX DATA SHEET
October 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number RE-12

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 2 - 5, 2006

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%

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: 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)
<i>Populus tremuloides</i>	<i>Salix sp.</i>	<i>Eriogonum sp.</i>	<i>Agrostis stolonifera</i>
<i>Salix sp.</i>	<i>Artemisia tridentata</i>	<i>Equisetum arvense</i>	<i>Juncus longistylis.</i>
	<i>Rosa woodsii</i>		<i>Juncus arcticus</i>
			<i>Carex nebrascensis</i>
			<i>Poa secunda</i>

POOL ATTRIBUTES

- % area in pools: *10 (water present)*
- % 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: *25*
- % 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) 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.
- 4) Water was present.
- 5) Vegetation cover looked good but see notes on the next page.

6) Heavy flooding was observed July 19-20, 2006. Consequently, in many areas like this one, there was much debris 7-8 ft above the water level. Also there were lots of sediments within the riparian species, often covering them. Live aspen on the side slopes just above the stream had toppled (photographs are on file).

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

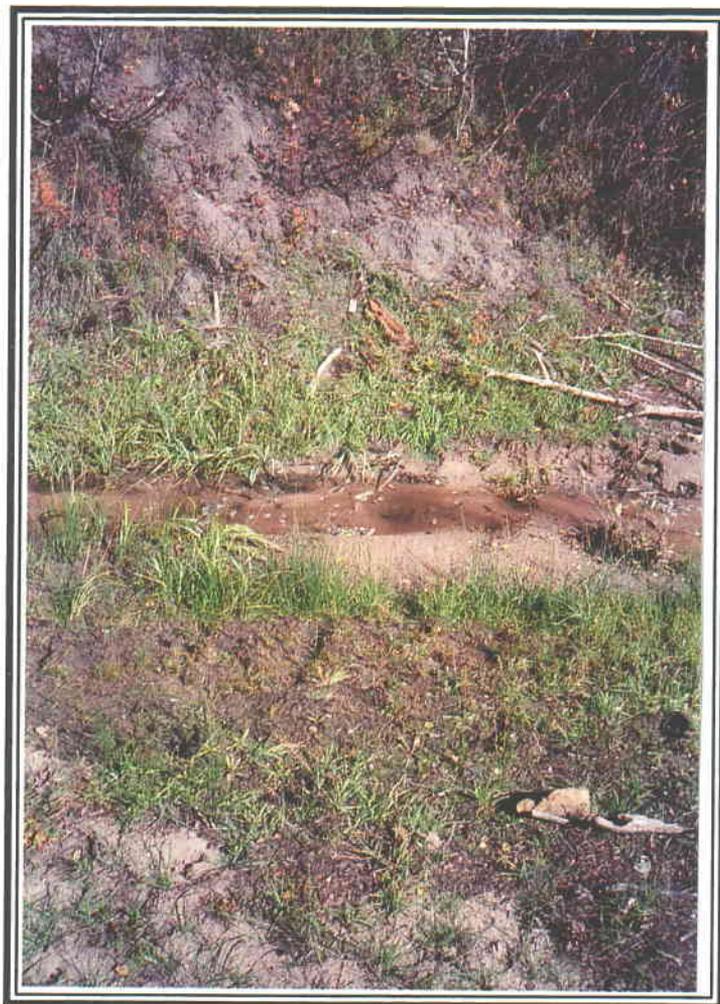
Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
RE-12		Left	6.0	<i>Juncus longistylis</i> / <i>Agrostis stolonifera</i>
		Right	1.5	<i>Agrostis stolonifera</i> / <i>Carex nebrascensis</i>
		Channel	2.0 2.0	Water Bareground

RE-12: Cover by community types in Box Canyons (October 2006)

USDA Forest Service Protocol (1992)

	Cover (ft)
UPLAND VEGETATION	
<i>Artemisia tridentata</i> / <i>Poa secunda</i>	8.00
	10.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera</i> / <i>Juncus arcticus</i>	5.00
<i>Agrostis stolonifera</i> / <i>Carex nebrascensis</i>	1.50
<i>Juncus arcticus</i>	1.00
TOTAL COVER (Upland Species)	18.00
TOTAL COVER (Riparian Species)	7.50
BAREGROUND	0.00
ROCK	2.00
WATER/MUD/DRY CHANNEL	2.00
Moss	0.00
TOTAL COVER	29.50

PHOTOGRAPHIC DOCUMENTATION



RE-12

RIPARIAN COMPLEX DATA SHEET

October 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number RE-13

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 2 - 5, 2006

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: decreasing

ESTIMATED FORAGE PRODUCTION: 75 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)
<i>Picea pungens</i>	<i>Artemisia tridentata</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Potentilla fruticosa</i>	<i>Equisetum arvense</i>	<i>Carex lanuginosa</i>
<i>Pinus ponderosa</i>	<i>Symphoricarpos oreophilus</i>	<i>Artemisia dracunculus</i>	<i>Elymus trachycaulus</i>
		<i>Erigeron divergens.</i>	<i>Juncus sp.</i>
		<i>Achillea millefolium</i>	<i>Juncus arcticus</i>
		<i>Lupinus sp.</i>	<i>Festuca ovina</i>
			<i>Poa secunda</i>

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: 10

BANK CONDITION

- % bank length vegetated, stable: 30
- % 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) There was lots of sand on banks and bottoms from the recent flooding.
- 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 :

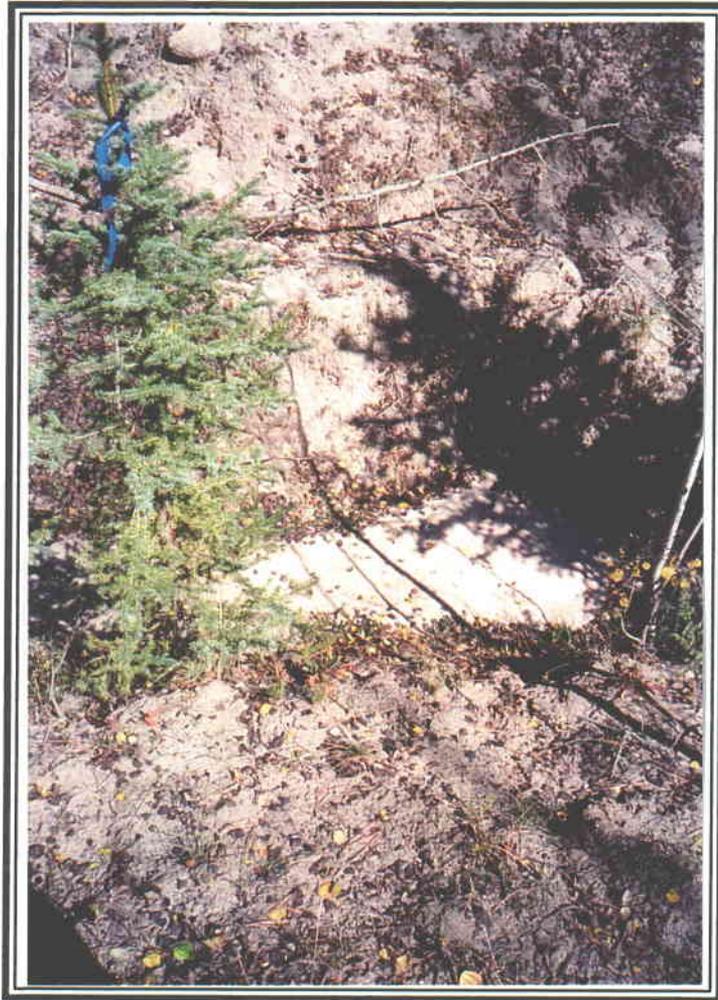
Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
RE-13		Left	1.5	<i>Agrostis stolonifera</i>
		Right	2.5	<i>Agrostis stolonifera</i>
		Channel	3.0	Rock & Bareground

RE-13: Cover by community types in Box Canyons (October 2006)

USDA Forest Service Protocol (1992)

	Cover (ft)
UPLAND VEGETATION	
<i>Artemisia tridentata/Poa secunda</i>	11.00
<i>Populus tremuloides/Festuca ovina</i>	9.50
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera</i>	4.00
TOTAL COVER (Upland Species)	20.50
TOTAL COVER (Riparian Species)	4.00
BAREGROUND	3.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	0.00
Moss	0.00
TOTAL COVER	27.50

PHOTOGRAPHIC DOCUMENTATION



RE-13

RIPARIAN COMPLEX DATA SHEET

October 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-07

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 2 - 5, 2006

OBSERVER(S): P.D. Collins

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: NW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: $\sim 2^\circ$

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)
<i>Picea pungens</i>	<i>Juniperus communis</i>	<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Potentilla fruticosa</i>	<i>Equisetum arvense</i>	<i>Carex lanuginosa</i>
<i>Betula occidentalis</i>		<i>Urtica dioica</i>	<i>Juncus longistylis</i>
		<i>Artemisia ludoviciana</i>	<i>Festuca ovina</i>
		<i>Geranium richardsonii</i>	

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°): 30
- % bank length gently sloping (>135°): 35
- % bank length with overhanging vegetation: 35

BANK CONDITION

- % bank length vegetated, stable: 25
- % bank length unvegetated, stable: 40
- % 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) 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) Area seemed to have little impact from recent flooding. I'm not sure as much rain hit this area.
- 4) Part of riparian spp. are in the channel.
- 5) No water at site.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

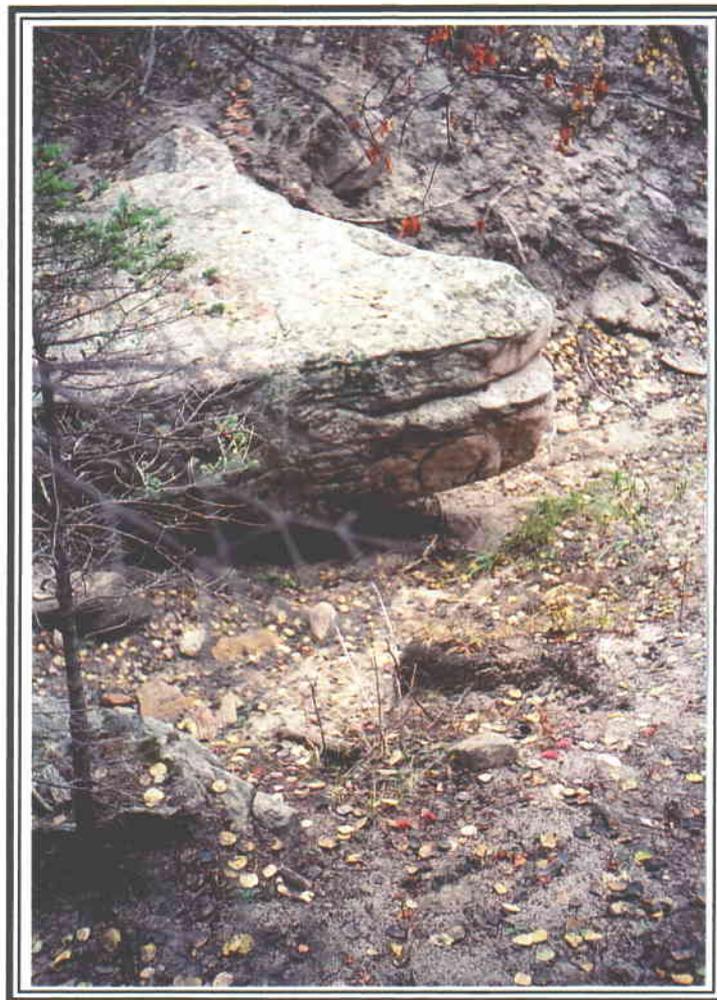
Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-07		Left	4.5	<i>Agrostis stolonifera</i> / <i>Carex lanuginosa</i>
		Right	0.0	
		Channel	4.5 2.0	Bareground Rock

R-7: Cover by community types in Box Canyons (October 2006)

USDA Forest Service Protocol (1992)

	Cover (ft)
UPLAND VEGETATION	
<i>Picea pungens</i> / <i>Equisetum arvense</i>	11.00
<i>Populus tremuloides</i> / <i>Festuca ovina</i>	17.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Carex lanuginosa</i> / <i>Agrostis stolonifera</i>	4.50
TOTAL COVER (Upland Species)	28.00
TOTAL COVER (Riparian Species)	4.50
BAREGROUND	4.50
ROCK	2.00
WATER/MUD/DRY CHANNEL	0.00
Moss	0.00
TOTAL COVER	39.00

PHOTOGRAPHIC DOCUMENTATION



R-07

RIPARIAN COMPLEX DATA SHEET

October 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-09

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 2 - 5, 2006

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: 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)
<i>Picea pungens</i>	<i>Salix lutea</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Equisetum arvense</i>	<i>Juncus longistylis</i>
<i>Juniperus scopulorum</i>	<i>Rosa woodsii</i>	<i>Urtica dioica</i>	<i>Juncus arcticus</i>
			<i>Carex lanuginosa</i>
			<i>Festuca ovina</i>

POOL ATTRIBUTES

% area in pools: 100

% 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: 50

BANK CONDITION

% bank length vegetated, stable: 85

% bank length unvegetated, stable: 10

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 5

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) The left side of the river there were mostly riparian species. It was difficult to tell if it was from hillside water or stream. Seemed more like stream influence.
- 4) The right side had hillside water influence.

5) Area seemed to have little impact from recent flooding.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

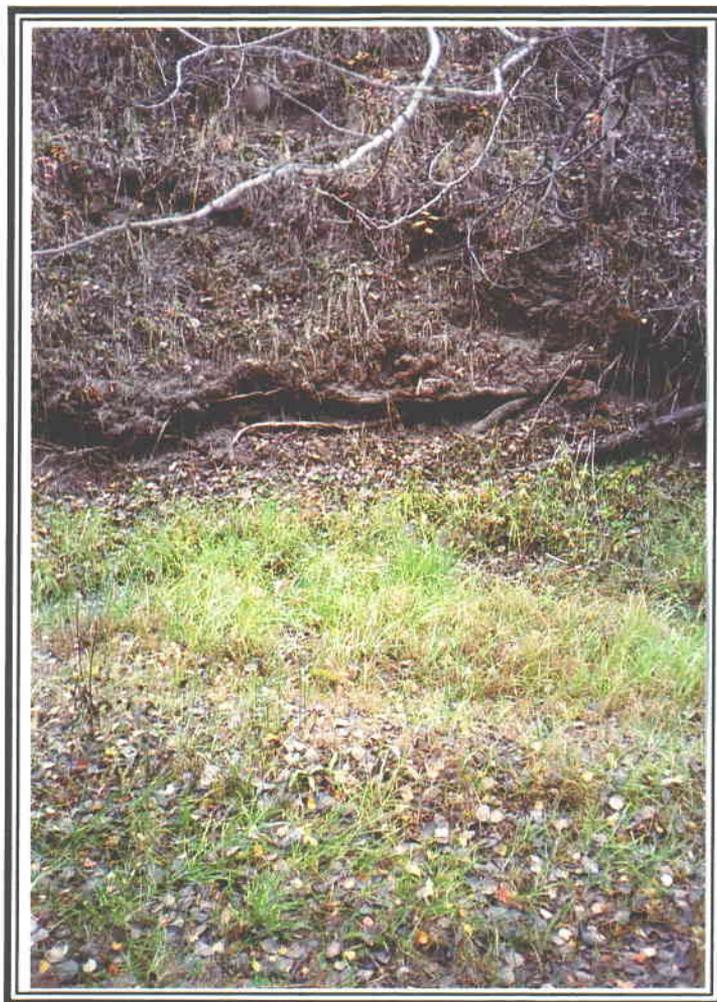
Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-09		Left	6.0	<i>Equisetum arvense/Agrostis stolonifera/Carex lanuginosa</i>
		Right	1.5	<i>Equisetum arvense</i>
		Channel	1.0	Water

R-9: Cover by community types in Box Canyons (October 2006)

USDA Forest Service Protocol (1992)

	Cover (ft)
UPLAND VEGETATION	
<i>Populus tremuloides/Festuca ovina</i>	20.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Carex lanuginosa/Agrostis stolonifera</i>	2.50
<i>Equisetum arvensis</i>	5.00
TOTAL COVER (Upland Species)	20.00
TOTAL COVER (Riparian Species)	7.50
BAREGROUND	0.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	1.50
Moss	0.00
TOTAL COVER	29.00

PHOTOGRAPHIC DOCUMENTATION



R-09

RIPARIAN COMPLEX DATA SHEET
October 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-11

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 2 - 5, 2006

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: 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)
<i>Picea pungens</i>	<i>Rosa woodsii</i>	<i>Epilobium angustifolium</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Equisetum arvense</i>	<i>Juncus longistylis</i>
<i>Salix sp.</i>		<i>Ranunculus cymbalaria</i>	<i>Juncus arcticus</i>
			<i>Poa secunda</i>

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°): 40

% bank length gently sloping (>135°): 60

% 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):
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.
- 3) Right stake was missing. For transect, we measured from aspen tree (see photo) with blue flag.
- 4) Left side ave. 80% veg [ave. of two sides therefore 40% (see Bank Condition above)].
- 5) Left side had more riparian vegetation and less upland.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

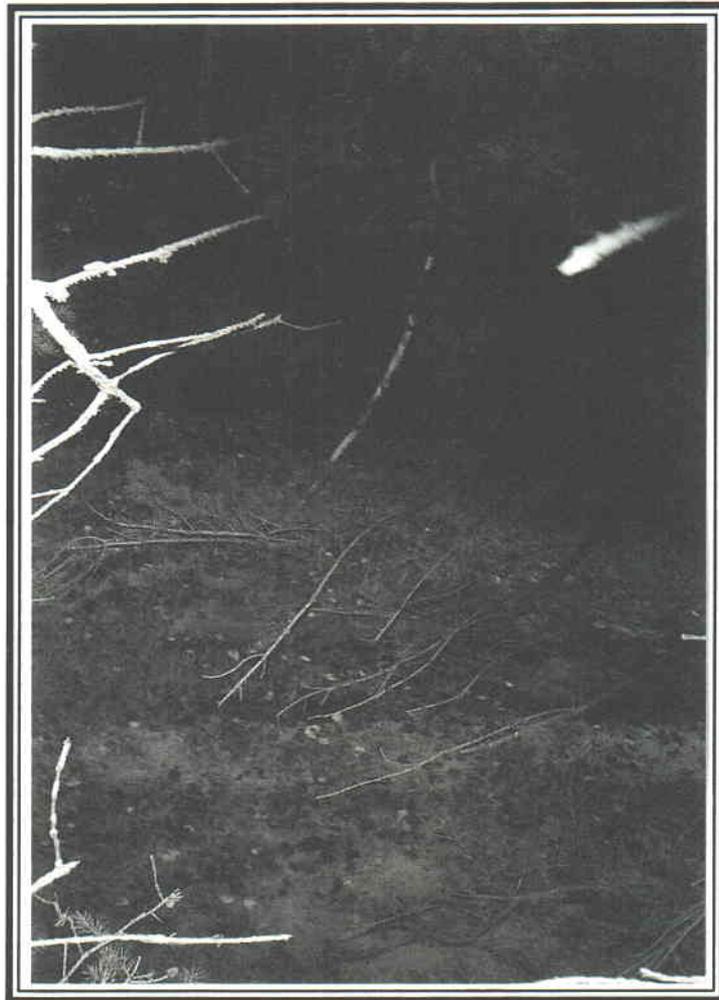
Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-11		Left	6.5	<i>Equisetum arvense/Agrostis stolonifera/Juncus longistylis</i>
		Right	2.0	<i>Equisetum arvense/Juncus longistylis</i>
		Channel	1.0 2.0	Water Bareground

R-11: Cover by community types in Box Canyons (October 2006)

USDA Forest Service Protocol (1992)

	Cover (ft)
UPLAND VEGETATION	
<i>Populus tremuloides</i>	15.50
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera/Juncus longistylis</i>	3.50
<i>Equisetum arvensis</i>	3.00
<i>Equisetum arvensis/Juncus longistylis</i>	2.00
TOTAL COVER (Upland Species)	15.50
TOTAL COVER (Riparian Species)	8.50
BAREGROUND	2.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	1.00
Moss	0.00
TOTAL COVER	27.00

PHOTOGRAPHIC DOCUMENTATION



R-11

RIPARIAN COMPLEX DATA SHEET

October 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-13

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 2 - 5, 2006

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: stable

ESTIMATED FORAGE PRODUCTION: 700 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)
<i>Picea pungens</i>	<i>Potentilla fruticosa</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Juniperus communis</i>	<i>Cirsium sp.</i>	<i>Carex nebrascensis</i>
<i>Salix lucida</i>		<i>Ranunculus cymbalaria</i>	<i>Carex lanuginosa</i>
<i>Salix sp.</i>			<i>Juncus longistylis</i>
			<i>Bromus carinatus</i>
			<i>Elymus trachycaulus</i>
			<i>Juncus arcticus</i>
			<i>Poa fendleriana</i>

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°): 50
- % 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, October 2004, July 2005, October 2005, July 2006 were consistent at 45 ft, October (46 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) About 15 ft of right side riparian community (Redtop/Wiregrass) was influenced by tributary on that side but this influence appeared less this sample period for unknown reasons.
- 5) The upper banks were wetland and probably influenced by the stream water.
- 6) Redtop was increasing and dominated the riparian community as a whole.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-13		Left	10.5	<i>Agrostis stolonifera/Carex nebrascensis/Equisetum arvense</i>
		Right	8.5	<i>Salix lutea/Carex nebrascensis/Equisetum arvense</i>
		Channel	0	Bareground

R-13: Cover by community types in Box Canyons (October 2006)

USDA Forest Service Protocol (1992)

Cover (ft)

UPLAND VEGETATION

Picea pungens/Equisetum arvense 27.00

RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

Agrostis stolonifera 6.00

Equisetum arvensis/Carex nebrascensis 8.50

Equisetum arvensis/Salix sp. 4.50

TOTAL COVER (Upland Species) 27.00

TOTAL COVER (Riparian Species) 19.00

BAREGROUND 0.00

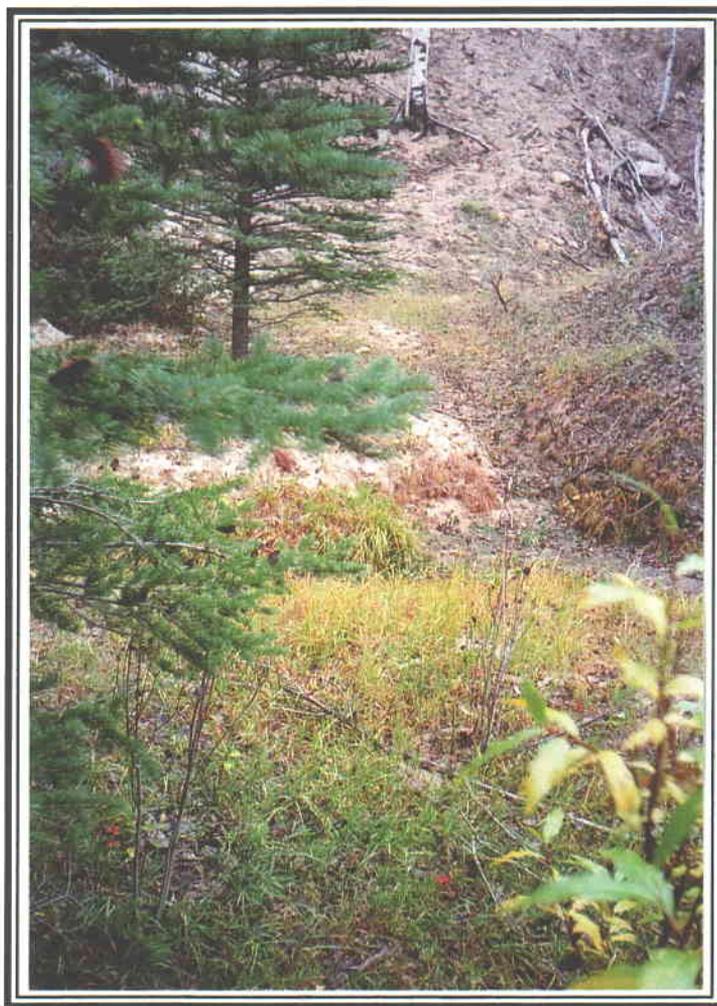
ROCK 0.00

WATER/MUD/DRY CHANNEL 0.00

Moss 0.00

TOTAL COVER 46.00

PHOTOGRAPHIC DOCUMENTATION



R-13

RIPARIAN COMPLEX DATA SHEET
October 2006

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-15

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 2 - 5, 2006

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)
<i>Picea pungens</i>	<i>Juniperus communis</i>	<i>Aster sp.</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Symphoricarpos oreophilus</i>	<i>Equisetum arvense</i>	
<i>Cornus stolonifera</i>	<i>Salix lutea</i>	<i>Epilobium angustifolium</i>	
	<i>Rosa woodsii</i>		

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°): 5
 % bank length with overhanging vegetation: 20

BANK CONDITION

% bank length vegetated, stable: 25
 % bank length unvegetated, stable: 30
 % bank length vegetated, unstable: 5
 % 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; since that time it has been fairly consistent (26.0 ft.; 25.5 Oct. 2006).

- 4) Photo from 1999 was from a different place (stake number indicated I was in the correct location in the following sample years).
- 5) Right side had patchy vegetation and sandy bareground areas. Left side had virtually no riparian vegetation.
- 6) The severe flooding mentioned in the East Fork in July 2006 did not seem to impact the Main Fork as much. Perhaps it rained more in the Main Fork, or maybe it is the nature of the two channels due to other environmental influences.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

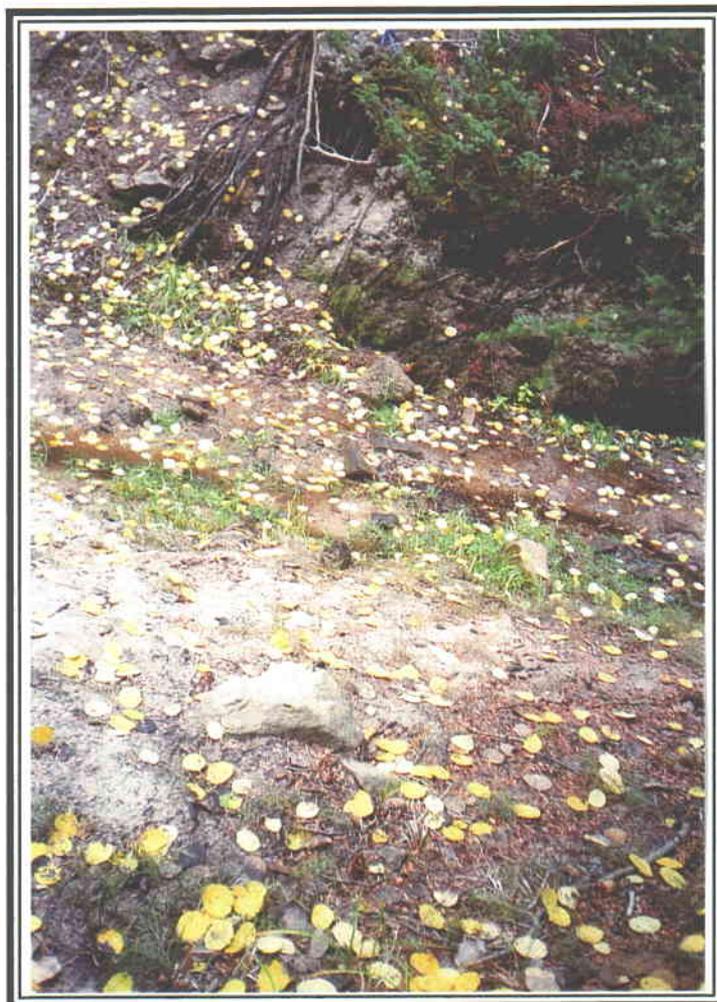
Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-15		Left	3.0	<i>Agrostis stolonifera</i>
		Right	0	
		Channel	2.0	Water
			3.0	Bareground/Rock

R-15: Cover by community types in Box Canyons (October 2006)

USDA Forest Service Protocol (1992)

	Cover (ft)
UPLAND VEGETATION	
<i>Populus tremuloides/Rosa woodsii</i>	17.50
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera</i>	3.00
TOTAL COVER (Upland Species)	17.50
TOTAL COVER (Riparian Species)	3.00
BAREGROUND	3.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	2.00
Moss	0.00
TOTAL COVER	25.50

PHOTOGRAPHIC DOCUMENTATION



R-15

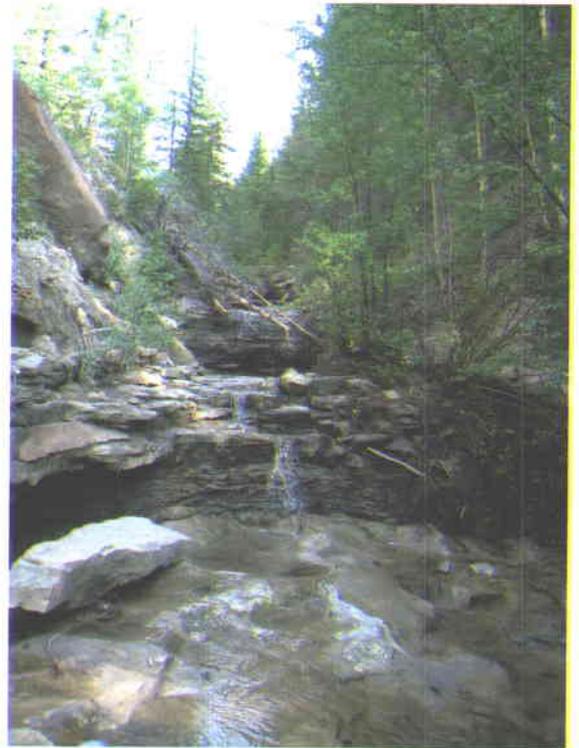
East Fork of Box Canyon Studies-Macroinvertebrate

Canyon Fuel Company, LLC – Sufco Mine has not received a copy of the 2006 Macroinvertebrate Survey Report to date. A copy of the 2006 Macroinvertebrate Study will be submitted when Consultant completes it.

**Report of Hydrologic
Monitoring of the East Fork of
Box Canyon Creek, 2006
Sufco Mine**

26 March 2007

Canyon Fuel Company, LLC
Sufco Mine
Salina, Utah



PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

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Box Canyon Creek, 2006
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26 March 2007

Canyon Fuel Company, LLC
SUFCO Mine
Salina, Utah

Prepared by:



Erik C. Petersen, P.G.
Senior Hydrogeologist
Utah P.G. No. 5373615-2250



PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

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**Report of Hydrologic Monitoring of the
East Fork of Box Canyon Creek, 2006**

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 (3LPE) longwall panel commenced beneath a portion of the East Fork of Box Canyon Creek, a 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 undermined and subsided. During 2005, longwall mining in the 4LPE and 5LPE panels occurred beneath the upper reaches of the East Fork of Box Canyon drainage (Figure 1). During 2006 mining occurred in the 6LPE longwall panel, which is the easternmost and final Pines longwall mining panel (Figure 1).

In accordance with Sufco's approved mining plan for the undermining of the East Fork, Canyon Fuel Company committed to performing routine monitoring of discharge rates in potentially impacted stream reaches and springs. Canyon Fuel Company commissioned Petersen Hydrologic, LLC to perform this monitoring, commencing in October 2003. The results of the ongoing monitoring activities at the East Fork of Box Canyon through 2006 are summarized in this report. During 2006, additional monitoring of springs and recently

constructed piezometers in the North Water Canyon area (a tributary to the East Fork of Box Canyon) was performed. A report summarizing the results of hydrologic monitoring in the North Water Canyon area is presented in a separate report (Petersen Hydrologic, LLC, 2007)

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 Company. During this site visit, locations along the East Fork of Box Canyon Creek and at adjacent springs were selected for flow 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.

Additional monitoring data in the East Fork drainage were collected as part of Canyon Fuel Company's regular quarterly hydrologic monitoring program (DOGGM, 2006).

- 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 vehicle. 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 a suitable 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 a few instances, such as where stream flow was partially obscured beneath ice, discharge rates in the East Fork were estimated.
- The monitoring station was digitally photographed during each 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 are the locations of the 3, 4, 5, and 6 Left Pines East longwall panels in the East Fork area. Discharge measurements for the East Fork of Box Canyon Creek and nearby springs for the period 2003 - 2006 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 drainage that is tributary to Box Canyon Creek (Figure 1). Box Canyon Creek is tributary to Muddy Creek about 2 miles below the study area. Historically, discharge in the East Fork of Box Canyon Creek during the summer and fall months has ranged from about 8 to 22 gpm at the confluence with Box Canyon Creek (Utah Division of Oil, Gas and Mining, 2006, on-line hydrology database). Appreciably higher flows are common during the spring runoff season and during heavy precipitation events.

Historically, the upper extent of perennial discharge in the East Fork of Box Canyon Creek has occurred below monitoring site EFB-6 (Sufco quarterly monitoring site Pines 106).

Above station EFB-6, the drainage is commonly dry or has only meager discharge (<1 gpm; Table 1). Below EFB-6, the discharge in the creek gradually increases downstream as a result of discharge from shallow groundwater systems. Based on observations of the stream channel made 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 (below subsided areas) 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 condition 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.

It is noteworthy that climatic conditions in the region have varied substantially during the period of monitoring at the East Fork of Box Canyon (2003-2006). This is illustrated in a plot of the Palmer Hydrologic Drought Index (PHDI) for Utah Region 4 (Figure 2). The PHDI is a monthly numerical value generated by the National Climatic Data Center (NCDC) that indicates the severity of wet and dry spells. The PHDI is calculated from various hydrologic parameters including precipitation, temperature, evapotranspiration, soil water recharge, soil water loss, and runoff. Consequently, it is useful for evaluating the relationship between climatic conditions and groundwater discharge and potentiometric data. It is apparent in Figure 2 that the region was experiencing a mild to moderate drought during late 2003 and the first three quarters of 2004. Beginning in October of 2004 the region began a gradual transition into wetter climatic conditions. During 2005, the region experienced a

continuous period of extreme wetness (Figure 2). During late 2005 the region began a gradual transition to the mild to moderate wetness conditions that persisted throughout 2006 (PHDI data are currently available through November 2006 only).

5.0 Discussion

On 10 October 2003, prior to undermining in the East Fork drainage, the East Fork monitoring stations were monitored and inspected to document pre-mining conditions in the canyon. The East Fork of Box Canyon Creek was first undermined using full-extraction longwall mining techniques in the 3LPE panel starting in mid November 2003 (Figure 1). Undermining of the East Fork drainage in the 3LPE panel continued as mining progressed southward until early January 2004. Undermining of the upper reaches of the East Fork of Box Canyon in the 4LPE longwall panel began in early 2005 and continued for several months. During November and December of 2005 the middle reaches of the North Water Canyon area were undermined in the 5LPE longwall panel. The last longwall panel in The Pines area (6LPE) was mined during 2006. Mining in the 6LPE panel occurred beneath the headwaters area of the main stem of the East Fork of Box Canyon drainage and in the North Water Canyon area (Figure 1).

It was noted that discharge in the East Fork increased appreciably shortly after the stream was first undermined in late 2003 with the 3LPE longwall panel (Table 1). A similar occurrence was observed at spring Pines 214 (Table 1). This condition was anticipated and was most

likely related to 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 3. It is apparent in Figure 3 that the discharge in the East Fork increased rapidly during November 2003 as mining progressed beneath the area, then declined rapidly during December 2003 and January 2004 as the longwall face passed beyond the region.

It was predicted prior to mining that tension fractures in the East Fork stream substrate would likely have small (less than ½-inch) apertures. Inspection of the stream substrate in 2003-2004, after subsidence related to mining of the 3LPE had occurred, confirmed that this was generally the case. Similarly, tension fractures in the East Fork stream channel overlying the 4LPE and 5LPE longwall panels were observed to have small apertures. Other than some moderate bedrock cracking/buckling of a short (~40-foot) section of the stream substrate immediately above monitoring station EFB-7, tension cracking of the stream channel overlying the 4LPE and 5LPE was relatively minor. Little or no cracking of the East Fork channel substrate overlying the 6LPE panel was observed. This is likely because the East Fork channel is developed mostly on alluvial sediments, which obscure the underlying bedrock in the 6LPE area.

Prior to mining in the East Fork, it was also anticipated that tension cracks in the stream channel would be “dead-end” openings that would not convey surface water out of the East

Fork drainage or downward into the Sufco Mine. Based on 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 longwall mining beneath the East Fork of Box Canyon Creek. Stream discharge data from the East Fork area measured during 2005 and 2006 continue to support that conclusion. It is apparent in the 2005 data that discharge in the creek increased appreciably in response to the wetter climatic conditions the region experienced during 2005. During 2006, discharge in the East Fork and nearby springs was somewhat less than that measured during 2005, which is attributable to the considerably dryer climatic conditions the region experienced during 2006 (Figure 2).

In Figure 4, the maximum discharge measured in the creek (station EFB-11, located near the middle of the 3LPE panel) is plotted against the maximum downstream discharge rate below the subsided area (stations EFB-11A, B, or C) for the period 2003 - 2006. It is apparent in Figure 4 that the quantity of water flowing out of the subsided area is similar to the maximum quantity measured upstream in the creek (at EFB-11). During the spring and summer months of 2004, the discharge at the downstream monitoring site was slightly less than that measured above, while in November of 2004 and during 2005 the discharge at the downstream site was greater than that measured above. During 2006 the flow in the stream below the subsidence area was generally similar to the maximum flows measured higher in the stream (Figure 4). Additionally, discharge rates measured at the Sufco quarterly water monitoring station Pines 408 (Lower East Fork at confluence with the main fork of Box Canyon Creek; Figure 1) during 2005 and 2006 are generally similar to the maximum measured up-stream discharge in

the creek (EFB-11; Figure 5). This strongly suggests that there has not been an appreciable or quantifiable loss of water from the East Fork drainage during 2005 and 2006.

The fact that groundwater contributions to stream baseflow have occurred consistently at the stream monitoring stations above EFB-11 subsequent to undermining suggests that stream flow was likewise not removed from the drainage in this area (i.e., the groundwater system is discharging water to the stream rather than receiving recharge from the stream). Based on this information, and the fact that the overall discharge in the creek was generally similar to that observed and measured in pre-mining years, there is no evidence to suggest that appreciable quantities of surface water have 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 discharges from three springs located along the base of the Castlegate Sandstone cliff on the northeast hillside above the creek (EFB-12, EFB-13, and EFB-14) ceased. Decreases in discharge from spring Pines 214 were also measured during this time (Table 1). During baseflow conditions in October 2003, the combined flow from the springs was approximately 3.0 gpm (Table 1). Although it was considered unlikely, it had been predicted prior to mining that discharge from these springs could be diverted small distances down-gradient as a result of mining-induced cracking of bedrock near the springs. It is apparent that this phenomenon occurred at these springs. Although discharge to the surface at these spring locations ceased, new groundwater discharge locations were observed near the stream channel a short distance below and

downstream of the previous discharge locations at about the same time as discharge at the spring locations diminished. Continued discharge from the new spring locations was observed during 2006. This discharge occurs both as measurable discrete spring flow in several locations in this and other nearby locations and also as diffuse discharge to the saturated colluvial sediments on the hillside in the area. Although the total discharge from this system is not readily quantifiable, it does not seem unreasonable to conclude that the discharge is on the order of that previously discharging from springs EFB-12, EFB-13, and EFB-14.

An additional 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 5. In Figure 6, discharge measurements from monitoring stations during six 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), late-season baseflow conditions after repairs to the stream channel (discussed later) had been performed (2 November 2004), during late spring runoff in a wet year (1 June 2005), during baseflow conditions in a wet year (27 October 2005), during late spring runoff in a moderately wet year (19 May 2006), and during baseflow conditions of a moderately wet year (31 Oct 2006). It is apparent in each of these plots that discharge rates in the East Fork generally increased downstream from EFB-6 to EFB-11 (which corresponds to the area of

spring discharge from near the base of the Castlegate Sandstone). 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 contributions to baseflow discharge to the creek would not be anticipated. That the stream continues to gain water through this reach under all seasonal and climatic conditions at magnitudes similar to those 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.

When the East Fork drainage was visited early 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 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 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 was 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).

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.

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 rocks from the channel substrate, revealing the surface flow beneath. In other locations, this was accomplished by placing bentonite in the stream channel in tension cracked zones. These repairs were successful in restoring surface water flow in essentially all of the stream reaches in the 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 continuous, although portions of the drainage were obscured by snow and ice cover. Discharge measurements and site observations made during 2005 confirmed the presence of continuous, substantial discharge in the stream from EFB-7 to the confluence with the Main Fork of Box Canyon during all 2005 site visits. Likewise, there was no indication of any downstream diminution in creek discharge that would indicate that surface flow was being diverted into the subsurface.

During the springtime of 2006, discharge in the East Fork appeared to be continuous from EFB-7 to the confluence with the main fork of Box Canyon. Zones of visibly diminished flow were not apparent anywhere in this portion of the drainage. Overall, discharge rates measured in the East Fork during 2006 were somewhat less than those measured during 2005 (Table 1). This condition would be anticipated as a result of the substantially dryer climatic conditions experienced in the region during 2006 (Figure 2).

It should be noted that although the stream sediments at EFB-6 were saturated, no discharge was measured at EFB-6 during 2006. As discussed previously, perennial stream flow in the East Fork historically began at or near EFB-6. Historically, for several hundred feet above this location the stream channel was usually dry (a few wet spots were sometimes present in intermittent locations in the East Fork above EFB-6). Historically, commencing at EFB-6 the stream gradually increased rapidly in flow at downstream locations. During 2006, although there was no flow at the EFB-6 monitoring point, perennial flow began about 40 to 50 feet below EFB-6 and the stream gained rapidly downstream from that point in a manner similar to that occurring in previous years. The fact that the emergence of perennial flow in the East Fork changed by only a few tens of feet laterally suggests that hydrogeologic conditions in the area likely have not changed greatly.

On 19 July 2006, a torrential thunderstorm event occurred in the East Fork drainage. On that date, precipitation measured at Sufco's East Fork Weather Station located adjacent to EFB-2 totaled 1.17 inches in a two-hour period. Based on field observations subsequent to the precipitation event, it was apparent that the discharge was focused in the North Water Canyon area and that a surface-water discharge several feet deep rushed down North Water Canyon and subsequently down the main stem of the East Fork to the confluence with the main fork of Box Canyon. There was no indication of a torrential flood of water in either the East Fork above EFB-6 or in the main fork of Box Canyon above Pines 407. Upon inspection of the East Fork drainage below EFB-6 subsequent to the storm, it was readily

apparent that substantial changes to the stream morphology in the stream had occurred. In many locations, alluvial and colluvial sediments underlying and directly adjacent to the stream were eroded away, leaving bare, exposed bedrock channel substrate. Additionally, in some areas where loose or highly weathered bedrock was present in the stream substrate, this material was removed by the torrential stream flow leaving significantly altered stream channel configuration. Photographs of the East Fork stream channel after the torrential precipitation event are shown in Figure 7. An additional torrential precipitation event was recorded at the East Fork Weather Station on 5 October 2006, with a measured rainfall of 1.79 inches in a 24-hour period.

Subsequent to the torrential precipitation events, discharge rates in the East Fork were monitored on 31 October 2006. Discharge rates measured at this time were generally consistent with the climatic conditions in the region at that time (Table 1; Figure 2).

However, the discharge rate measured at EFB-9 was somewhat lower than anticipated (about 4.6 gpm lower than EFB-8). Additionally, a reach of dry stream substrate about 50-75 feet in length was observed a short distance above EFB-10 in October 2006. This condition is likely attributable to changes in the stream channel morphology resulting from the torrential thunderstorm events (which were substantial at EFB-9). Additionally, the bentonite repairs performed to the stream channel by Sufco personnel in this vicinity during 2004 may have been compromised by the runoff event. However, it is important to note that the overall stream flow gain between EFB-6 and EFB-11 measured at that time is consistent with that anticipated for the climatic conditions. Additionally, the downstream discharge measured at

Pines 408 (28.7 gpm; DOGM 2006) is greater than the maximum upstream discharge measured at that time, strongly suggesting that no net-loss of water from the drainage occurred.

It is noteworthy that discharge from spring Pines 214 has increased steadily since August 2004, continuing through 2006 (Figure 8; Table 1). Pines 214 flowed at approximately 2 gpm prior to undermining, then surged to 37 gpm concurrent with undermining in November 2003, then declined to as little as 0.08 gpm in June 2004 after mining had occurred. Since August 2004 the discharge has increased steadily from 0.09 gpm to 0.87 gpm in October 2006. Discharge from EFB-8 spring has apparently not been affected by mining-induced subsidence and continued to discharge at greater than pre-mining rates in 2006 (Figure 9).

As discussed above, discharge data from the East Fork stream channel above EFB-6 indicate that the East Fork drainage is usually mostly dry above EFB-6. During 2003 and 2004, all monitoring stations above EFB-6 were dry, with the exception of a small discharge (~0.5 gpm) measured at EFB-4 (Table 1). Discharge near EFB-4 was typically present for a distance of several tens to hundreds of feet above or below the EFB-4 during 2003-2004. Additionally, during 2003-2004 there were a few localized muddy/damp zones a few tens of feet in length present between EFB-5 and EFB-2. During 2005 and 2006, no discharge was measured at EFB-4, although muddy/damp zones continued to be present in the East Fork between EFB-5 and EFB-2 (including near EFB-4). Stream flow in the poorly defined stream channel above EFB-2 was not observed prior to 2006, nor was it observed in 2006.

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Petersen Hydrologic, LLC, 2007, Investigation of Subsidence-Related Impacts to Groundwater Systems in the North Water and Joes Mill Pond areas and Proposed Groundwater Mitigation Activities, Sufco Mine, Unpublished consulting report for Canyon Fuel Company, LLC.

Utah Division of Oil, Gas and Mining, 2006, On-line hydrology database, Sufco Mine, <http://ogm.utah.gov/coal/edi/wqdb.htm>.

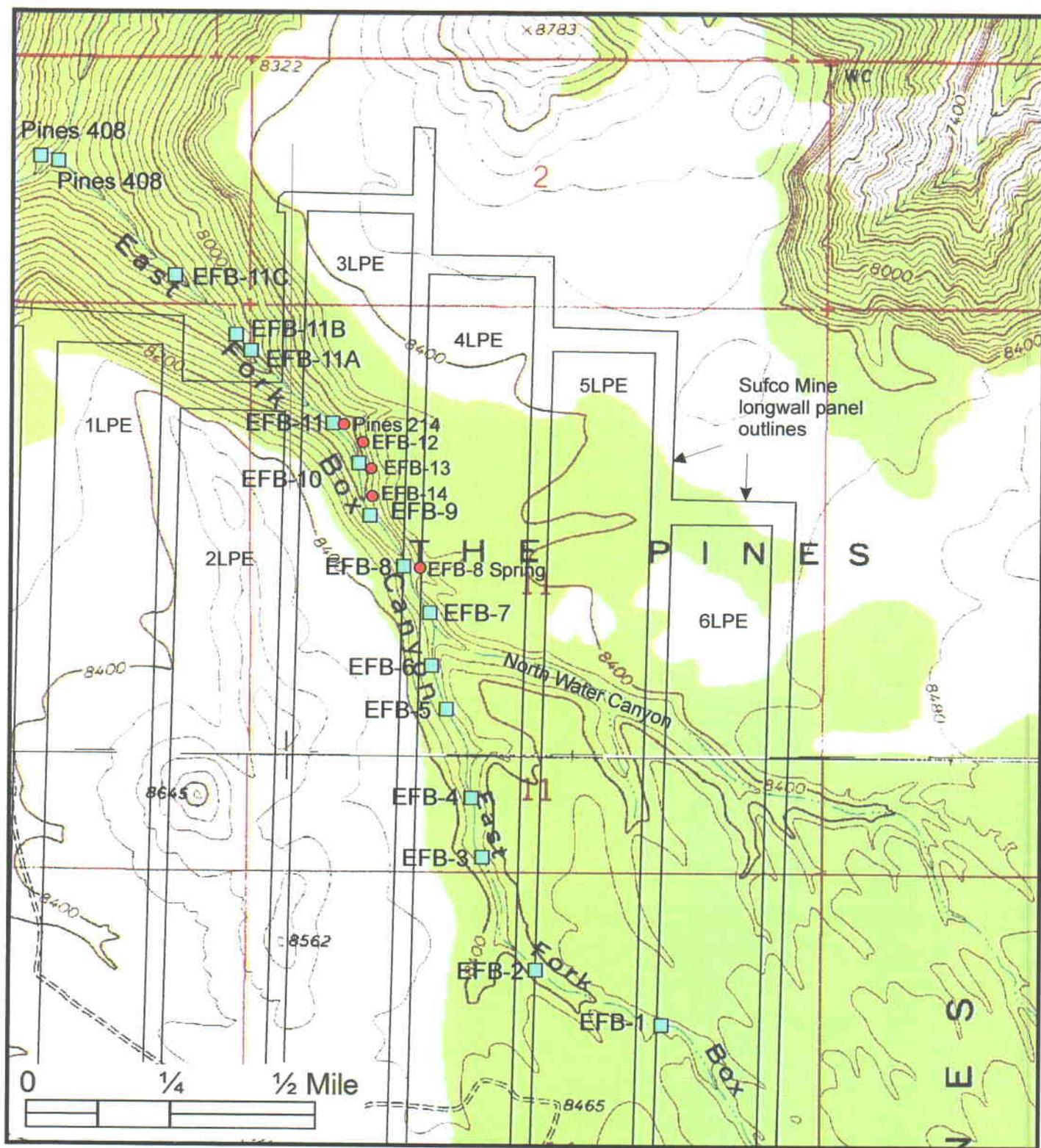


Figure 1 Monitoring locations in the East Fork of Box Canyon.

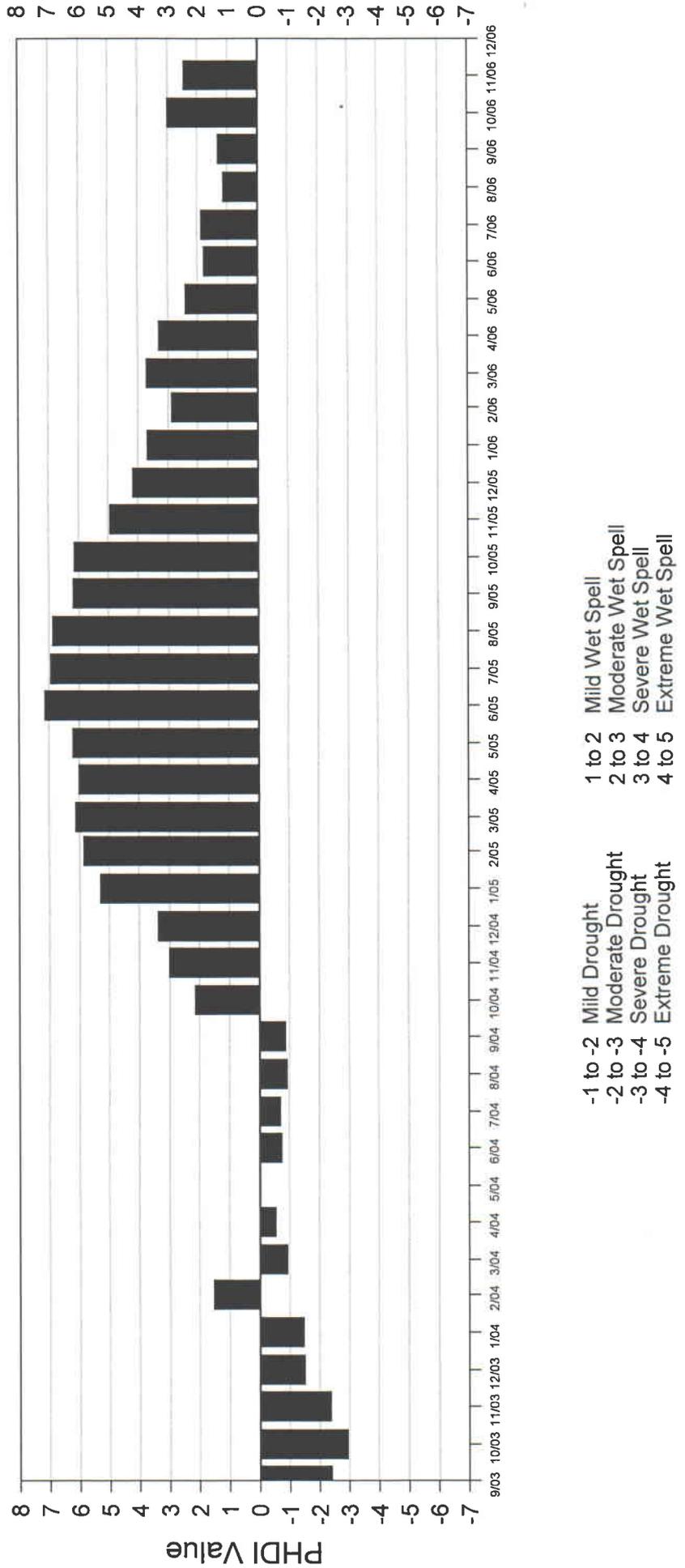


Figure 2 Plot of Palmer Hydrologic Drought Index for Utah Region 4.

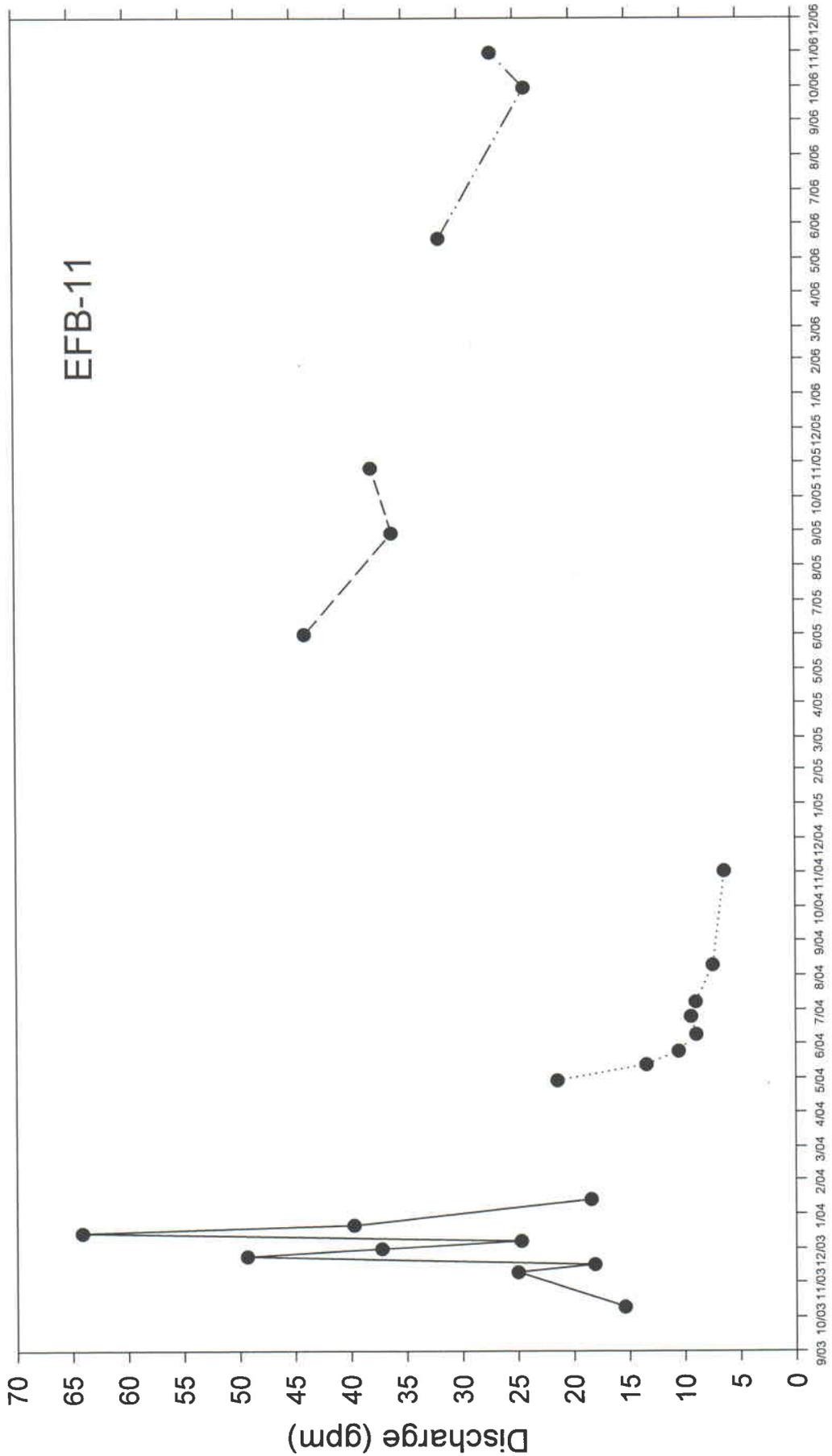


Figure 3 Discharge in the East Fork of Box Canyon Creek at monitoring station EFB-11.

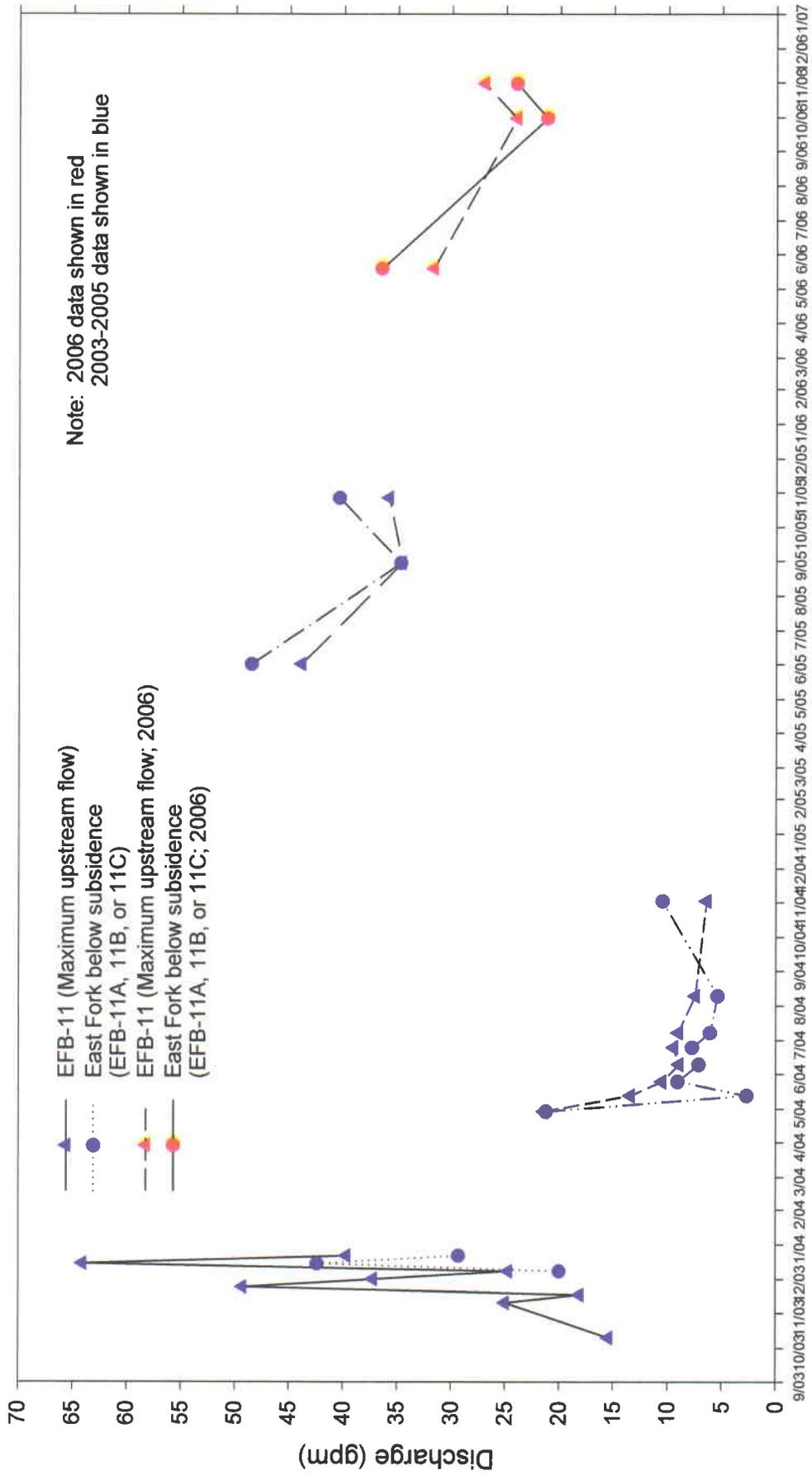


Figure 4 Comparison of maximum discharge in the East Fork of Box Canyon Creek

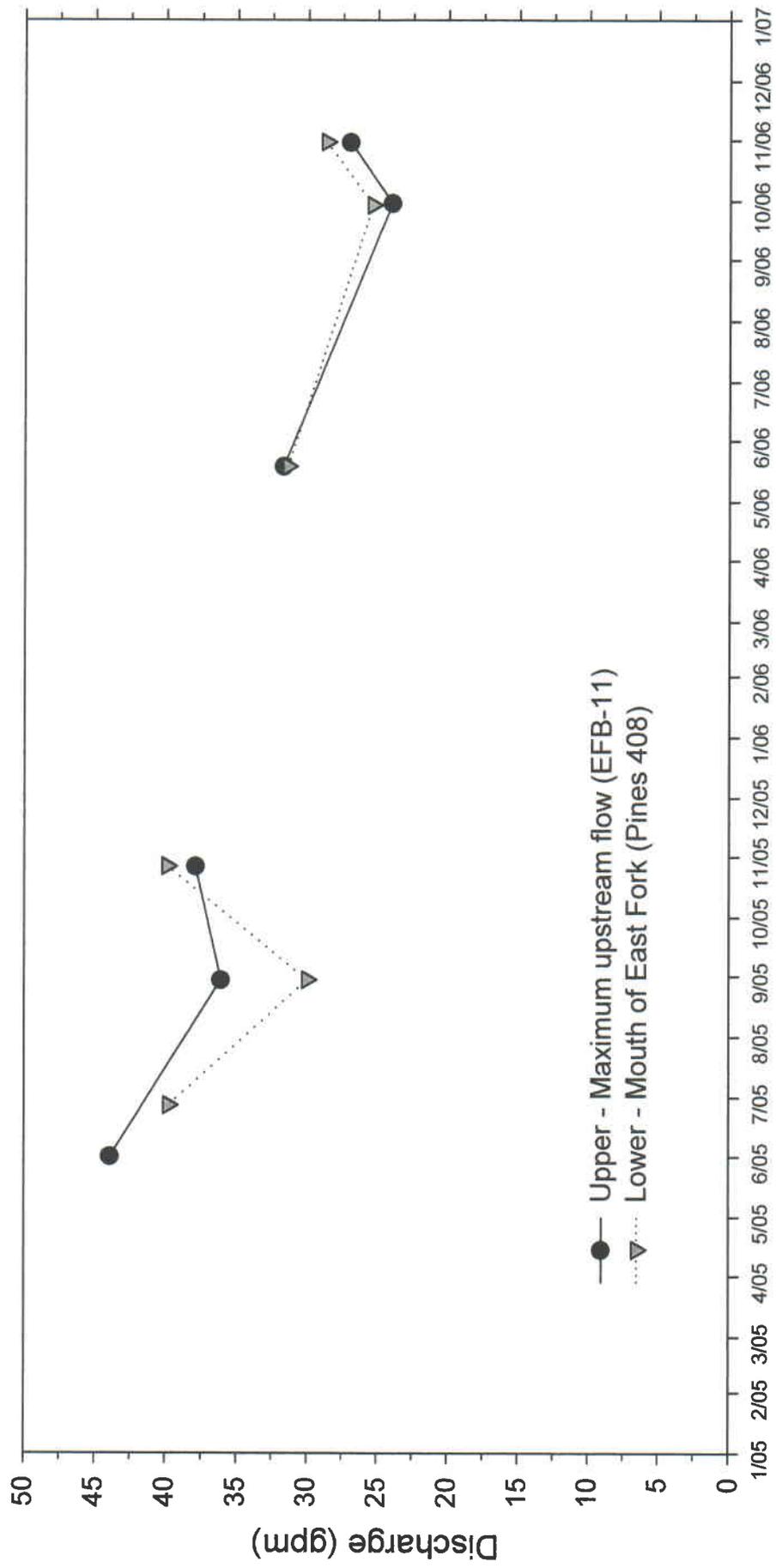
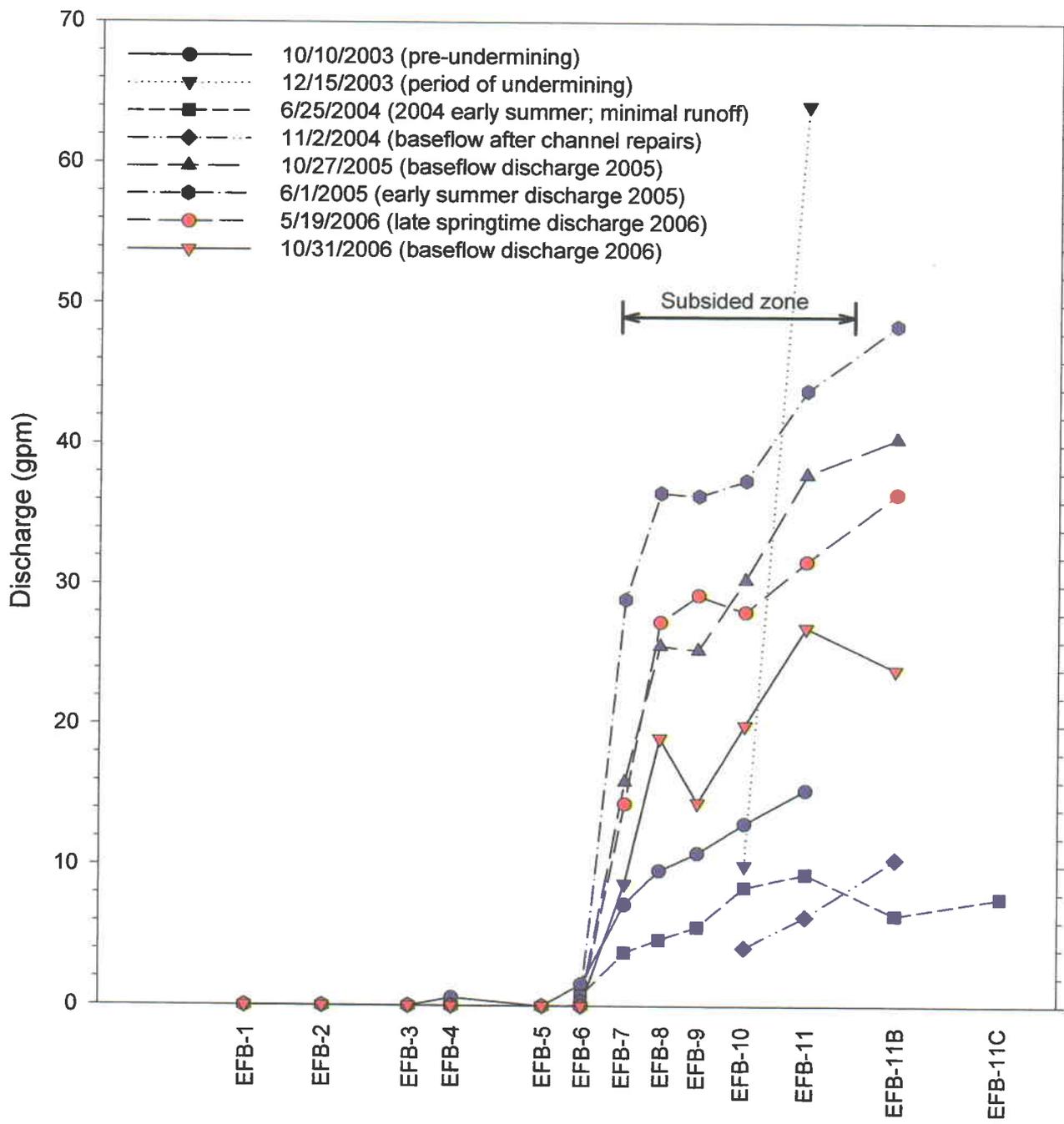


Figure 5 Comparison of maximum upstream flow in the East Fork of Box Canyon with discharge at the lower mouth.



Note: 2005 data shown in red.
Discharge data from EFB-11A not shown on graph.

Figure 6 Plots of discharge from East Fork of Box Canyon Creek monitoring sites.



Stream channel at EFB-8

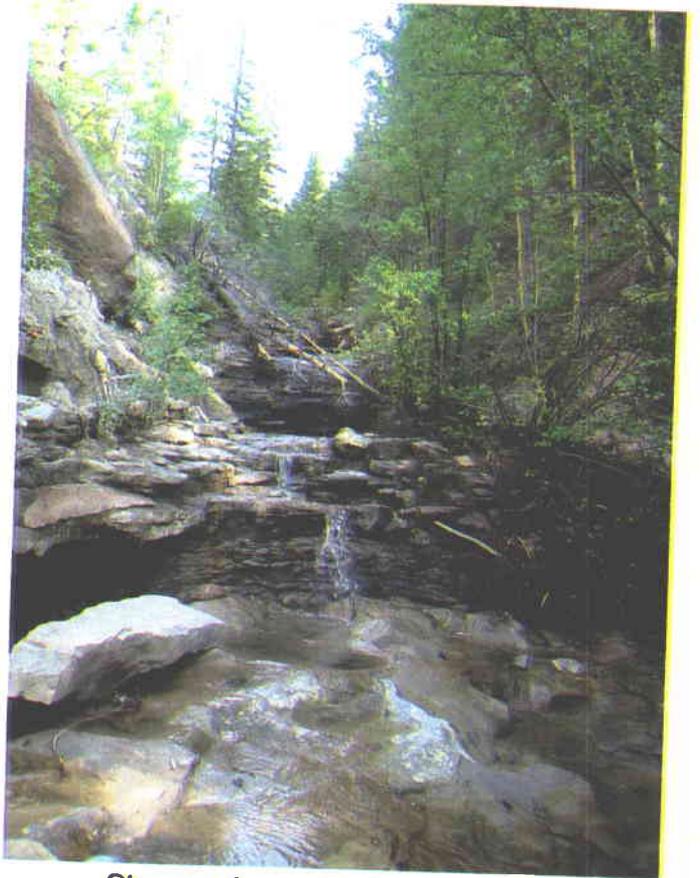


Stream channel below EFB-11

Figure 7 Photographs of the East Fork stream channel after the 19 July 2006 torrential thunderstorm runoff event.



Stream channel below EFB-11



Stream channel below EFB-11



Stream channel near EFB-11A

Figure 7 continued.

Pines 214

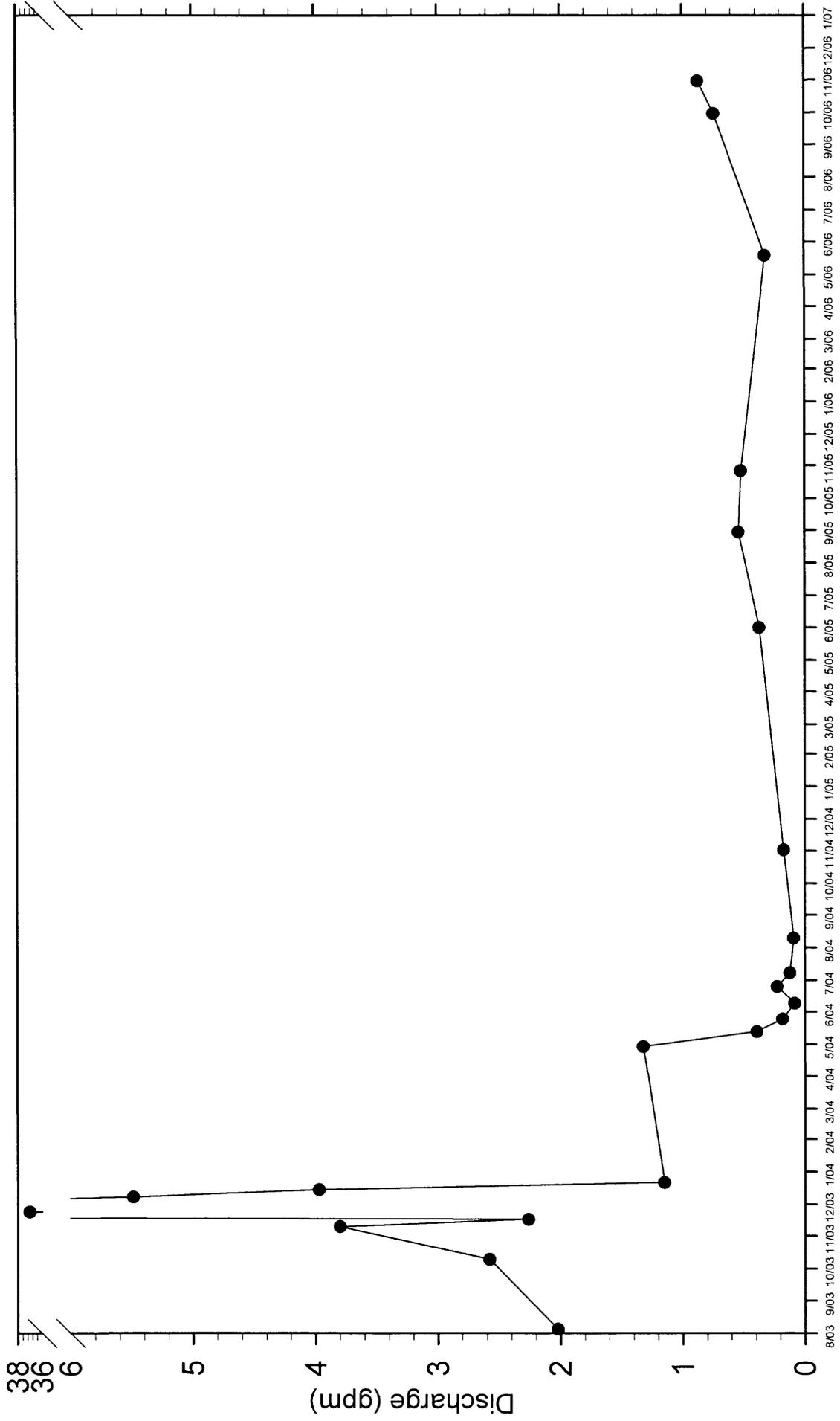


Figure 8 Discharge hydrograph for spring Pines 214.

EFB-8 spring

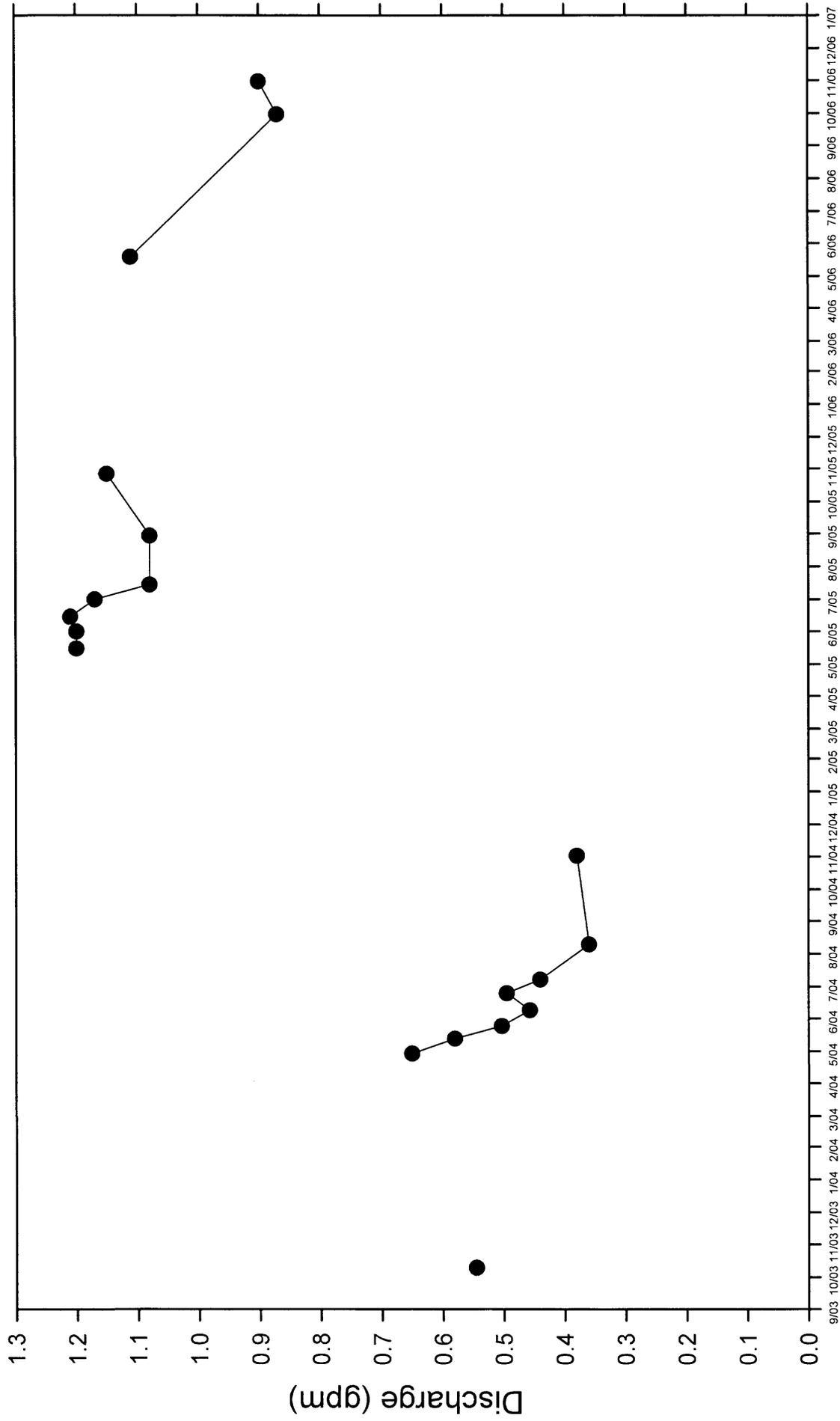


Figure 9 Discharge hydrograph for EFB-8 spring.

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 2006

APPENDIX E

Other Information

In accordance with the requirements of R645-301 and R645-302

CONTENTS

None