Canyon Fuel Company, LLC
A Subsidiary of Arch Western Bituminous Group, LLC

Task ID #4554

Sufco Mine
Kenneth E. May
General Manager
597 South SR24
Salina, Utah 84654
(435) 286-4400
Fax (435) 286-4499

March 25, 2014

Permit Supervisor, Utah Coal Regulatory Program
Utah Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
PO Box 145801
Salt Lake City, UT 84114-5801

Re: 2013 Annual Report, Canyon Fuel Company, Sufco Mine, C/041/002

Dear Sirs:

Please find enclosed with this letter a paper copy and flash drive copy of the 2013 Annual Report for the Sufco Mine. The formats are slightly different due to the scanning required for documents on the flash drive.

If you have questions or need addition information please contact Vicky Miller at (435)286-4481.

CANYON FUEL COMPANY, SUFCO Mine

John D. Byars
Technical Services Manager

Encl.

cc: DOGM Correspondence File

Print Form | Submit by Email | Reset Form

Annual Report

This Annual Report shows information the Division has for your mine. Submit the completed document and any additional information identified in the Appendices to the Division by the date specified in the cover letter. During a complete inspection an inspector will check and verify the information.

GENERAL INFORMATION

Company Name	Canyon Fuel Company, LLC	Mine Name	SUFCO Mine
Permit Number	C/041/0002	Permit expiration Date	May 21, 2017
Operator Name		Phone Number	+1 (435) 286-4480
Mailing Address	597 South SR24	Email	vmiller@bowieresources.com
City	Salina		
State	UT	Zip Code	84654

		DOGM File Location or Annual Report Location
Excess Spoil Piles	☐ Required ☒ Not Required	
Refuse Piles	☒ Required ☐ Not Required	Attached
Impoundments	☒ Required ☐ Not Required	Attached
Other:		

OPERATOR COMMENTS

REVIEWER COMMENTS ☐ Met Requirements ☐ Did Not meet Requirements

COMMITMENTS AND CONDITIONS

The Permittee is responsible for ensuring annual technical commitments in the Mining and Reclamation Plan and conditions accepted with the permit are completed throughout the year. The Division has identified these commitments below and has provided space for you to report what you have done during the past year for each commitment. If additional written response is required, it should be filed as an attachment to this report.

Title: RAPTOR SURVEYS
Objective: To determine if there are active nest sites and the number of juveniles fledged within 1/2 mile of surface mining activities or areas that may be impacted by subsidence. The surveyor should obtain nest location data from DWR prior to conducting the survey. All data collected should be provided to DWR to update the database.
Frequency: Annually
Status: Ongoing
Reports: Annual
Citation: MRP, Volume 1, Chapter 3, page 3-9
Operator Comments

See attached.

Reviewer Comments ☐ Met Requirements ☐ Did Not Meet Requirements

Title: COLOR INFRARED PHOTOGRAPHY
Objective: To assess changes in vegetation due to mining. Photos submitted after 2008 must include an analysis between 2008 and current photos to assess changes in vegetation due to subsidence.
Frequency: Once every 5 years beginning in 2008.
Status: 2008 photos completed, Photos and analysis due in 2013.
Reports: Annual
Citation: MRP, Volume 1, Chapter 3, page 3-45, Chapter 5, page 5-29
Operator Comments

Submitted to the Division as part of an amendment in February. Summary is attached to this annual report refer the the amendment for copies of photos, which will eventually be incorporated into an appendix of the permit.

Reviewer Comments ☐ Met Requirements ☐ Did Not Meet Requirements

Title: PINES TRACT VEGETATION STUDY
Objective: To determine if longwall mining in the Pines Tract would potentially impact the Link Canyon Trail Columbine. The survey will include the portions of Box Canyon.
Frequency: Annually
Status: Ongoing
Reports: Annual
Citation: MRP, Volume 1, Chapter 3, Page 3-22B, page 3-45 A.

Operator Comments

Submitted to the Division as part of an amendment in February. Summary is attached to this annual report, the study will eventually be incorporated into an appendix of the permit.

Reviewer Comments ☐ Met Requirements ☐ Did Not Meet Requirements

Title: LINK CANYON PORTAL VEGETATION STUDY
Objective: To determine if there are any impacts to the vegetation surrounding the portal area.
Frequency: Annually, June, September and November
Status: Ongoing, **Please include a determination regarding the impact of the portals on the area's vegetation.**
Reports: Annual
Citation: MRP, Volume 1, Chapter 3, page 3-45A
Operator Comments

Submitted to the Division as part of an amendment in February. Reports are attached to this annual report, but will eventually be incorporated into an appendix of the permit.

Reviewer Comments ☐ Met Requirements ☐ Did Not Meet Requirements

Title: SUBSIDENCE MONITORING
Objective: To document the amount of subsidence that has occurred.
Frequency: Annually
Status: Ongoing
Reports: Annual
Citation: MRP, Volume 1, Chapter 5, page 5-29

Operator Comments

See attached.

Reviewer Comments ☐ Met Requirements ☐ Did Not Meet Requirements

Title: CLIMATOLOGICAL DATA
Objective: Collect climatological data to aid in determining the impact to runoff, stream flow and local springs from mining.
Frequency: Annually
Status: Ongoing
Reports: Annual
Citation: MRP, Volume 2, page 7-51E

Operator Comments

See attached

Reviewer Comments ☐ Met Requirements ☐ Did Not Meet Requirements

Title: WASTE ROCK SAMPLING
Objective: To document chemical characteristics of waste rock and protect surface and groundwater. Quarterly sampling, Number of samples/volume not described. Refer to tables 3 and 8 in the Division's 2008 Soils and Overburden Handling Guide.
Frequency: Quarterly, during periods of deposition at the waste rock site.
Status: Ongoing
Reports: Annual, indicate frequency of sampling (#samples/volume).
Citation: MRP, Volume 3, Section 3, page 3-4

Operator Comments

See attached.

Reviewer Comments ☐ Met Requirements ☐ Did Not Meet Requirements

FUTURE COMMITMENTS AND CONDITIONS

The following commitments are not required for the current annual report year, but will be required by the permittee in the future as indicated by the "status" field. These commitments are included for information only, and do not currently require action. If you feel that the commitment is no longer relevant or needs to be revised, please contact the Division.

OPERATOR COMMENTS (OPTIONAL)

REVIEWER COMMENTS

REPORTING OF OTHER TECHNICAL DATA

Please list other technical data or information that was not included in the form above, but is required under the approved plan, which must be periodically submitted to the Division.

Please list attachments:

Vegetation monitoring for the South Fork of Quitchupah, commitment to complete monitoring is in the monitoring plan

Reviewer Comments

MAPS

Copies of mine maps, current and up-to-date, are to be provided to the Division as an attachment to this report in accordance with the requirements of R645-301-525.240. The map copies shall be made in accordance with 30 CFR 75.1200 as required by MSHA. Mine maps are not considered confidential.

Map Name	Map Number	Included		Confidential	
		Yes	No	Yes	No
Annual subsidence map		☒	☐	☐	☒
Mine Map		☒	☐	☐	☒
		☐	☐	☐	☐
		☐	☐	☐	☐
		☐	☐	☐	☐

Reviewer Comments ☐ Met Requirements ☐ Did Not Meet Requirements

IMPOUNDMENTS – 2013

09/09/10 MLD

CANYON FUEL COMPANY - SUFCO MINE

Rock Waste Sediment Pond Quarterly Inspection Report

Inspector Mike Davis Date 3-18-13

1. Dam Structural Weakness

A. Cracks or scarps on crest ___ Yes X No

None observed - snow covered x 1"

B. Cracks or scarps on slope ___ Yes X No

None observed - snow covered x 1"

C. Sloughing or bulging on slope ___ Yes X No

None observed

2. Major Erosion Problems ___ Yes X No

None observed

3. Surface Movements of Surrounding Slopes ___ Yes X No

None observed

4. Visible Sumps or Sinkholes in Slurry Surface ___ Yes X No

None observed - 4" water in bottom of pond

5. Clogging

A. Spillway channels and pipes ___ Yes X No

None observed

B. Decant System ___ Yes X No

Decant valve is closed + locked

C. Diversion ditches ___ Yes X No

Some spillage in West inlet ditch that needs to be cleaned out

6. Seepage (Specify Location, Color and Approx. Volume)

___ Yes X No

None observed

7. Any appearance of instability, structural weakness, or other hazardous conditions ___ Yes X No

None observed

8. Other Comments

Cool overcast day, temp ≈ 35°F

09/09/10 MLD

CANYON FUEL COMPANY - SUFCO MINE

Minesite Primary Sediment Pond Quarterly Inspection Report

Inspector Mike Davis Date 3-15-13

1. Dam Structural Weakness

A. Cracks or scarps on crest ___ Yes X No

None observed

B. Cracks or scarps on slope ___ Yes X No

None observed on dam

C. Sloughing or bulging on slope ___ Yes X No

None observed on dam

2. Major Erosion Problems ___ Yes X No

No major erosion problems were observed - Minor erosion on slope above pond

3. Surface Movements of Surrounding Slopes ___ Yes X No

None observed

4. Visible Sumps or Sinkholes in Slurry Surface ___ Yes X No

None observed - pond full of water

5. Clogging

A. Spillway channels and pipes ___ Yes X No

None observed

B. Decant System ___ Yes X No

Decant system is closed and locked

C. Diversion ditches ___ Yes X No

None observed

6. Seepage (Specify Location, Color and Approx. Volume) ___ Yes X No

None observed

7. Any appearance of instability, structural weakness, or other hazardous conditions ___ Yes X No

None observed

8. Weir level X Yes ___ No

9. Other Comments

Warm, clear day, temp 50°F

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09/09/10 MLD

CANYON FUEL COMPANY - SUFCO MINE

Minesite Sediment Overflow Pond Quarterly Inspection Report

Inspector Mike Davis Date 3-15-13

1. Dam Structural Weakness

A. Cracks or scarps on crest ___ Yes X No

None observed during inspection

B. Cracks or scarps on slope ___ Yes X No

None observed on dam

C. Sloughing or bulging on slope ___ Yes X No

None observed on dam

2. Major Erosion Problems ___ Yes X No

None observed

3. Surface Movements of Surrounding Slopes ___ Yes X No

None observed

4. Visible Sumps or Sinkholes in Slurry Surface ___ Yes X No

None observed — Pond was full of water

5. Clogging

A. Spillway channels and pipes ___ Yes X No

None observed - all clear

B. Decant System ___ Yes X No

Decant system is closed and locked

C. Diversion ditches ___ Yes X No

None observed

6. Seepage (Specify Location, Color and Approx. Volume) ___ Yes X No

No seepage was observed

7. Any appearance of instability, structural weakness, or other hazardous conditions ___ Yes X No

None observed

8. Weir level Inspected and scrapped weir plates X Yes ___ No

9. Other Comments

Warm clear day, temp 50°F

Sufco Upper Sediment Pond	Date	Time	Inspector(s) Signature	Quarterly Inspection Form
	6/26/2013	10:28	Vicky L. Miller vsm	

Mine Site Primary Pond	Action Required			Person Notified	Date Corrected	Comments/Remarks
	Yes/No	OK	N/A			
Stability of Pond						
Pond stability/weakness		X				
Erosion/Stability of banks		X				
Vegetation problem around pond		X				
Hazardous Condition						
Any visible contaminants			X			
Hazardous condition observed			X			
Inlet Conditions						
Inlet functioning		X				
Culvert(s)/ditches		X				
Principle & Emergency Spillways						
Water Discharging (rate)			X			
Pond water level			X			
Spillway is clear of debris		X				
Oil skimmer		X				
Emergency spillway		X				
Primary spillway		X				

Other Useful Information	Value	Comments/Remarks	Sediment Storage Capacity/ Elevation	Value	Comments/Remarks
Last cleaning date for pond	2012		100% sediment storage capacity (cubic/ft)	24,211	7410.4' (Elevation)
Primary Spillway elevation (ft)	7418.15		60% sediment storage capacity (cubic/ft)	14,527	7408.1' (Elevation)
Emergency Spillway elevation (ft)	7418.3		Current sediment Volume (est.)	50%	
			Remaining storage capacity (est.)	50%	

Other Observations: Pond **Empty** at time of inspection in preparation for cleaning

Sufco Lower Sediment Pond	Date	Time	Inspector(s) Signature	Quarterly Inspection Form
	5/13/2013	7:30	Vicky A Muller VSM	

Mine Site Overflow Pond	Action Required			Person Notified	Date Corrected	Comments/Remarks
	Yes/No	OK	N/A			
Stability of Pond						
Basin stability/weakness		X				
Erosion/Stability of banks		X				
Vegetation problem around basin		X				
Hazardous Condition						
Any visible contaminants			X			
Hazardous condition observed			X			
Inlet Conditions						
Inlet functioning		X				
Culvert(s)/ditches		X				
Principle & Emergency Spillways						
Water Discharging (rate)		75 GPM				
Pond water level		Full				
Spillway is clear of debris		X				
Oil skimmer		X				
Emergency spillway		X				
Primary spillway		X				

Other Useful Information	Value	Comments/Remarks	Sediment Storage Capacity/ Elevation	Value	Comments/Remarks
Last cleaning date for basin			100% sediment storage capacity (acre/ft)		7245.41' (Elevation)
Primary Spillway elevation (ft)	7252.5		60% sediment storage capacity (acre/ft)		7243.62' (Elevation)
Emergency Spillway elevation (ft)	7253		Current sediment Volume (est.)	25%	
			Remaining storage capacity (est.)	75%	

Other Observations: Algae is heavy in the pond, ducks swimming in pond

Waste Rock Sediment Pond	Date	Time	Inspector(s) Signature	Quarterly Inspection Form
	5/1/2013	11:40	Shelly A. Miller vsm	

	Action Required			Person Notified	Date Corrected	Comments/Remarks
	Yes/No	OK	N/A			
Stability of Pond						
Pond stability/weakness		X				
Erosion/Stability of banks		X				
Vegetation problem around pond		X				
Hazardous Condition						
Any visible contaminants		NO				
Hazardous condition observed		NO				
Inlet Conditions						
Inlet functioning		X				
Culvert(s)/ditches		X				
Principle & Emergency Spillways						
Water Discharging (rate)			NA			Pond empty at time of inspection.
Pond water level			NA			
Spillway is clear of debris		X				
Oil skimmer		X				
Emergency spillway		X				
Primary spillway		X				

Other Useful Information	Value	Comments/Remarks	Sediment Storage Capacity/ Elevation	Value	Comments/Remarks
Last cleaning date for pond	2012		100% sediment storage capacity (acre/ft)		7885' (ELEVATION)
Primary Spillway elevation (ft)	7889.5		60% sediment storage capacity (acre/ft)		7886' (ELEVATION
Emergency Spillway elevation (ft)	7890.7		Current sediment Volume (est.)	10%	
			Remaining storage capacity (est.)	90%	

Other Observations: _____

ANNUAL MINESITE SEDIMENTATION OVERFLOW POND CERTIFICATION -- 2013

John D. Byars, P.E. on September 30, 2013 conducted an inspection of Canyon Fuel Company's SUFCO Minesite Sediment Overflow Pond.

There were no signs of structural weakness in the area of the sediment pond.

The fill slope above the pond was eroded with some minor gullies in random locations. There were no signs of instability of the fill slope.

The decant structure appeared to be functional and the decant valve was locked.

The water in the pond was at an elevation of 7,252.5, which is at the standpipe spillway elevation. The sediment level in the pond just north of the decant structure was at 7,239.94. This elevation is 3.68 ft. below the 60% sediment level.

A copy of the field notes is attached.

I certify that the above description accurately represents the condition of the Minesite Sediment Pond as observed during my inspection on September 30, 2013

LICENSED PROFESSIONAL ENGINEER
No. 334504-2202
JOHN D. BYARS
STATE OF UTAH

John D. Byars, P.E.
Registration No. 334504
State of Utah

JDB:jn

Attachment

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09/09/10 MLD

CANYON FUEL COMPANY - SUFCO MINE

Minesite Sediment Overflow Pond Annual Inspection Report

Inspector [illegible] Date 9-30-13

1. Dam Structural Weakness

A. Cracks or scarps on crest ___ Yes X No

None observed

B. Cracks or scarps on slope ___ Yes X No

None observed

C. Sloughing or bulging on slope ___ Yes X No

None observed

2. Major Erosion Problems ___ Yes X No

None observed

3. Surface Movements of Surrounding Slopes ___ Yes X No

none observed

4. Visible Sumps or Sinkholes in Slurry Surface ___ Yes X No

None observed

5. Clogging

A. Spillway channels and pipes ___ Yes X No

clear - None observed

B. Decant System ___ Yes X No

Valve Locked

C. Diversion ditches ___ Yes X No

None observed

6. Seepage (Specify Location, Color and Approx. Volume)

___ Yes X No

none observed

7. Any appearance of instability, structural weakness, or other hazardous conditions ___ Yes X No

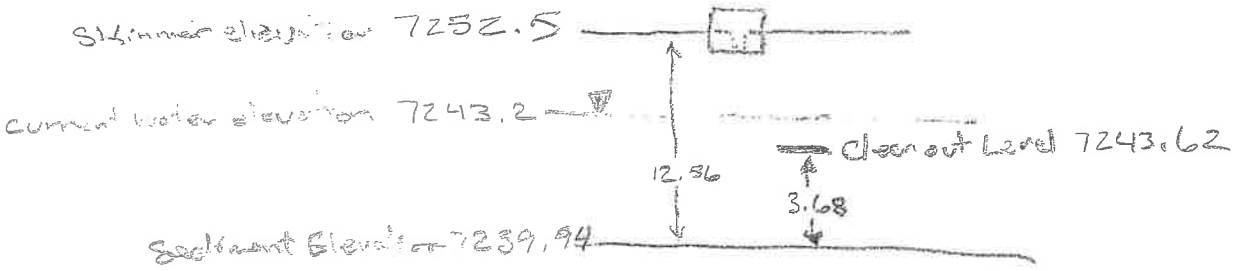
[illegible]

8. Weir level X Yes ___ No

9. Other Comments

Everything appears to be in normal operating condition

10. Drawing



ANNUAL MINESITE PRIMARY SEDIMENTATION POND CERTIFICATION -- 2013

John D. Byars, P.E. on September 30, 2013, conducted an inspection of Canyon Fuel Company's SUFCO Minesite Primary Sediment Pond.

There were no signs of structural weakness in the area of the sediment pond.

The fill slope above the pond was eroded with some minor gullies in random locations. There were no signs of instability of the fill slope.

The decant structure appeared to be functional and the decant valve was locked.

The standpipe spillway in the pond is at an elevation of 7,418.15. The water elevation is at 7,418.15. Approximately an additional 0.29 acre-ft. of storage volume was available in the pond above the current standpipe spillway level. The sediment level in the pond just north of the decant structure was at 7,405.65. This elevation is 2.45 ft. below the 60% sediment level.

A copy of the field notes are attached.

I certify that the above description accurately represents the condition of the Minesite Sediment Pond as observed during my inspection on September 30, 2013

LICENSED PROFESSIONAL ENGINEER
No. 334504-2202
JOHN D. BYARS
9-30-13
STATE OF UTAH

John D. Byars, P.E.
Registration No. 334504
State of Utah

JDB:jn

Attachment

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CANYON FUEL COMPANY - SUFCO MINE

Minesite Primary Sediment Pond Annual Inspection Report

Inspector John D. Bauer Date 9-30-13

1. Dam Structural Weakness

A. Cracks or scarps on crest ___ Yes X No

None observed

B. Cracks or scarps on slope ___ Yes X No

None observed

C. Sloughing or bulging on slope ___ Yes X No

None observed

2. Major Erosion Problems ___ Yes X No

None observed

3. Surface Movements of Surrounding Slopes ___ Yes X No

None observed

4. Visible Sumps or Sinkholes in Slurry Surface ___ Yes X No

None observed

5. Clogging

A. Spillway channels and pipes ___ Yes X No

clear - None observed

B. Decant System ___ Yes X No

Valve locked

C. Diversion ditches ___ Yes _✓_ No

None observed

6. Seepage (Specify Location, Color and Approx. Volume)

___ Yes _✓_ No

None observed

7. Any appearance of instability, structural weakness, or other hazardous conditions ___ Yes _✓_ No

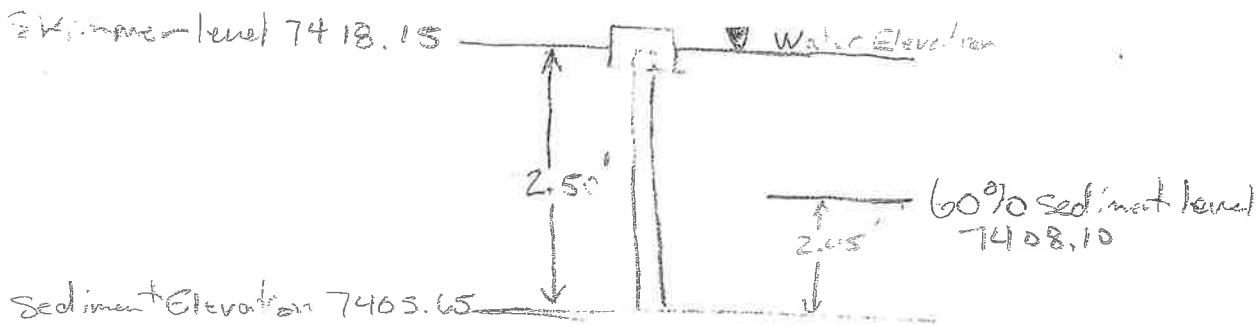
None observed

8. Weir level _✓_ Yes ___ No

9. Other Comments

Everything appears to be in normal operating condition this week.

10. Drawing



09/09/10 MLD

CANYON FUEL COMPANY - SUFCO MINE

Clear 75° Sunny

Rock Waste Sediment Pond Annual Inspection Report

Inspector John D. Byers Date 9-30-13

1. Dam Structural Weakness

A. Cracks or scarps on crest ___ Yes X No

None observed

B. Cracks or scarps on slope ___ Yes X No

None observed

C. Sloughing or bulging on slope ___ Yes X No

None observed

2. Major Erosion Problems ___ Yes X No

None observed

3. Surface Movements of Surrounding Slopes ___ Yes X No

None observed

4. Visible Sumps or Sinkholes in Slurry Surface ___ Yes X No

None observed

5. Clogging

A. Spillway channels and pipes ___ Yes X No

Clear - never used

B. Decant System ___ Yes X No

Clear - valve locked

C. Diversion ditches ___ Yes _X_ No

No [illegible]

6. Seepage (Specify Location, Color and Approx. Volume)

___ Yes _X_ No

None observed

7. Any appearance of instability, structural weakness, or other hazardous conditions ___ Yes _X_ No

None observed

8. Other Comments

[illegible]

10. Drawing

ANNUAL WASTE ROCK SEDIMENTATION POND CERTIFICATION -- 2013

John D. Byars, P.E. made an inspection of Canyon Fuel Company's SUFCO Mine Waste Rock Sediment Pond and associated Decant Impoundment on September 30, 2013.

No signs of structural weakness of the sediment pond dam or decant impoundment dam were observed.

The spillways and decant devices are in good condition and are functional.

The sediment level at the east inlet of the pond was at an elevation of 7,884.5 ft. The 60% sediment level for the pond is at 7885.15 ft. There is an additional 0.65 ft. of depth in the pond before the clean out level is reached.
An additional 5.00 ft. of depth is available in the pond before it would discharge through the primary spillway.

No sediment or water was observed in the decant impoundment.

A copy of the field notes of the inspection is attached.

I certify that the above description accurately represents the condition of the Waste Rock Sedimentation Pond and Decant Impoundment observed during the inspection conducted on September 30, 2013

LICENSED PROFESSIONAL ENGINEER
No. 334504-2202
JOHN D. BYARS
STATE OF UTAH

John D. Byars, P.E.
Registration No. 334504
State of Utah

JDB:jn

Attachment

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CANYON FUEL COMPANY - SUFCO MINE

Rock Waste Sediment Pond Quarterly Inspection Report

Inspector Amanda Richard Date 12/30/13

1. Dam Structural Weakness

A. Cracks or scarps on crest ___ Yes X No

None observed

B. Cracks or scarps on slope ___ Yes X No

None observed - Two slopes snow-covered ≈ 1"-4"

C. Sloughing or bulging on slope ___ Yes X No

None observed

2. Major Erosion Problems ___ Yes X No

None observed

3. Surface Movements of Surrounding Slopes ___ Yes X No

None observed

4. Visible Sumps or Sinkholes in Slurry Surface ___ Yes X No

None observed - Snow covered ≈ 4" in bottom of pond

5. Clogging

A. Spillway channels and pipes ___ Yes X No

None observed

B. Decant System ___ Yes X No

Valve is locked

C. Diversion ditches ___ Yes _X_ No

No obstructions - scattered snow cover

6. Seepage (Specify Location, Color and Approx. Volume)

___ Yes _X_ No

None observed

7. Any appearance of instability, structural weakness, or other hazardous conditions ___ Yes _X_ No

None observed

8. Other Comments

Cool sunny day, slight breeze, temperature ≈ 31° F

09/09/10 MLD

CANYON FUEL COMPANY - SUFCO MINE

Minesite Primary Sediment Pond Quarterly Inspection Report

Inspector Amanda Richard Date 12/26/13

1. Dam Structural Weakness

A. Cracks or scarps on crest ___ Yes X No

None observed

B. Cracks or scarps on slope ___ Yes X No

None observed

C. Sloughing or bulging on slope ___ Yes X No

None observed

2. Major Erosion Problems ___ Yes X No

No major erosion problems observed

3. Surface Movements of Surrounding Slopes ___ Yes X No

None observed

4. Visible Sumps or Sinkholes in Slurry Surface ___ Yes X No

None observed - pond full of water

5. Clogging

A. Spillway channels and pipes ___ Yes X No

None observed

B. Decant System ___ Yes X No

Valve is locked & closed

C. Diversion ditches ___ Yes X No

None observed

6. Seepage (Specify Location, Color and Approx. Volume)

___ Yes X No

None observed

7. Any appearance of instability, structural weakness, or other hazardous conditions ___ Yes X No

None observed

8. Weir level X Yes ___ No

9. Other Comments

Sunny, temperature ≈ 40°F

09/09/10 MLD

CANYON FUEL COMPANY - SUFCO MINE

Minesite Sediment Overflow Pond Quarterly Inspection Report

Inspector Amanda Richard Date 12/26/13

1. Dam Structural Weakness

A. Cracks or scarps on crest ___ Yes X No

None observed

B. Cracks or scarps on slope ___ Yes X No

None observed

C. Sloughing or bulging on slope ___ Yes X No

None observed

2. Major Erosion Problems ___ Yes X No

None observed

3. Surface Movements of Surrounding Slopes ___ Yes X No

None observed

4. Visible Sumps or Sinkholes in Slurry Surface ___ Yes X No

None observed - pond is full of water

5. Clogging

A. Spillway channels and pipes ___ Yes X No

None observed - clear

B. Decant System ___ Yes X No

Valve is closed & locked

C. Diversion ditches ___ Yes X No

None observed

6. Seepage (Specify Location, Color and Approx. Volume)

___ Yes X No

None observed

7. Any appearance of instability, structural weakness, or other hazardous conditions ___ Yes X No

None observed

8. Weir level X Yes ___ No

9. Other Comments

Sunny, slight breeze, temperature ≈ 35°F

WASTE ROCK – 2013

09/09/10 MLD

CANYON FUEL COMPANY - SUFCO MINE

Coal Refuse Pile Quarterly Inspection Report

Inspector Mike Davis Title Env. Engineer

Date 3-18-13 Permit # ACT/041/002

1. Foundation Preparation (vegetation, topsoil removal?) X Yes ___ No

2. Lift Thickness (inches) 18-22"

3. Compaction Piles on new lift need to be spread out and compacted X Yes ___ No

4. Burning (specify extent and location) ___ Yes X No

None observed during inspection

5. Angle of Slope (degrees) 20-25°

6. Seepage (specify location, color, & appr. volume) ___ Yes X No

None observed

7. Cracks or Scarps (location and size) ___ Yes X No

None observed

8. Major Erosion Problems (location and extent) ___ Yes X No

No major erosion problems

9. Water Impounding Against Toe ___ Yes X No

None observed

10. Any appearance of instability, structural weakness or other hazardous conditions ___ Yes X No

None observed

Cool overcast day, temps ≈ 35°F

John D. Byars, P.E.
Registration No. 334504-2202
State of Utah

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LICENSED PROFESSIONAL ENGINEER
No. 334504-2202
JOHN D. BYARS
3-25-13
STATE OF UTAH

CANYON FUEL COMPANY - SUFCO MINE

Coal Refuse Pile Quarterly Inspection Report

Inspector: Vicky Miller **Title:** Environmental Engineer

Date: May 1, 2013 **Permit #** ACT/041/002

1. Foundation Preparation (vegetation, topsoil removal?) X Yes __ No
2. Lift Thickness (inches) 12- 24"
3. Material being Compacted X Yes __ No
4. Burning (specify extent and location) __ Yes X No - None Observed
5. Angle of Slope (degrees) 20 - 25%
6. Seepage (specify location, color, & appr. volume) __ Yes X No
   None Observed
7. Cracks or Scarps (location and size) __ Yes X No - None Observed
8. Major Erosion Problems (location and extent) __ Yes X No
   None Observed
9. Water Impounded by Structure __ Yes X No - None Observed
10. Any appearance of instability, structural weakness or other hazardous conditions __ Yes X No
11. Erosion of Toe __ Yes X No - None Observed
12. Diversions Stable X Yes __ No

LICENSED PROFESSIONAL ENGINEER
No. 334504-2202
JOHN D. BYARS
STATE OF UTAH

6-20-13

John D. Byars, P.E.
Registration No. 334504-2202
State of Utah

I hereby certify that: I am experienced in the construction of earth and rock fill; I am qualified and authorized in the State of Utah to inspect and certify the condition and appearance of earth and rock fills and that inspections and inspection reports are made by myself or under my direction and include the appearances of instability, structural weakness or other hazardous condition of the structure which affect stability.

ANNUAL WASTE ROCK DISPOSAL SITE CERTIFICATION -- 2013

John D. Byars, P.E. on September 30, 2013 made an inspection of Canyon Fuel Company's SUFCO Mine Waste Rock Disposal Site.

The pad of the fifth cell has active dimensions of about 282 ft. x 191 ft. End-dumped piles of development waste were on the pad at the time of the inspection. This underground development waste is dumped from 10 wheel end-dump trucks in piles about 3.5-4 ft high. These piles are leveled with a D-7 Cat dozer or a 988 Cat loader. The resulting lift thickness is 18-24 inches. The dozer/loader and loaded trucks are routed over the pad to compact the lift.

Final and intermediate construction slopes were at or less than the designed 1v:2h (26.5°) on the south and west slope. Slopes are constructed such that water cannot collect against the toe.

The 5th cell has been started.

No fires have occurred at the site since it was constructed and none were observed during the inspection.

No significant erosion was observed at the time of inspection.

A copy of the field notes is attached.

Vegetation is growing abundantly on cells 1, 2, 3 and 4. The Vegetation consists of grass, brush and forbes.

I certify that the above description accurately represents the conditions observed at the Waste Rock Disposal Site during my inspection conducted September 30, 2013

John D. Byars, P.E.
Registration No. 334504
State of Utah

LICENSED PROFESSIONAL ENGINEER
No. 334504-2202
JOHN D. BYARS
STATE OF UTAH

JDB:jn

Attachment

Q:\GOVT2013\DOGM CORR\ANNUAL13.cert.doc

09/09/10 MLD

CANYON FUEL COMPANY - SUFCO MINE

Coal Refuse Pile Annual Inspection Report Clear 70°

Inspector John D Byars Title Manager of Tech Services

Date 9-30-13 Permit # ACT/041/002

1. Foundation Preparation (vegetation, topsoil removal?) X Yes ___ No

2. Lift Thickness (inches) 18"-24"

3. Compaction X Yes ___ No

4. Burning (specify extent and location) ___ Yes X No

None observed

5. Angle of Slope (degrees) 25°

6. Seepage (specify location, color, & appr. volume) ___ Yes X No

None observed

7. Cracks or Scarps (location and size) ___ Yes X No

None observed

8. Major Erosion Problems (location and extent) ___ Yes X No

None observed

9. Water Impounding Against Toe ___ Yes X No

None observed

10. Any appearance of instability, structural weakness or other hazardous conditions ___ Yes X No

None observed

LICENSED PROFESSIONAL ENGINEER No. 334504-2202 JOHN D. BYARS STATE OF UTAH

John D. Byars, P.E.
Registration No. 334504-2202
State of Utah

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09/09/10 MLD

CANYON FUEL COMPANY - SUFCO MINE

Coal Refuse Pile Quarterly Inspection Report

Inspector Amanda Richard Title Env Engineer

Date 12/30/13 Permit # ACT/041/002

1. Foundation Preparation (vegetation, topsoil removal?) X Yes ___ No

2. Lift Thickness (inches) 18" - 24"

3. Compaction X Yes ___ No

4. Burning (specify extent and location) ___ Yes X No

None Observed

5. Angle of Slope (degrees) 25°

6. Seepage (specify location, color, & appr. volume) ___ Yes X No

None Observed

7. Cracks or Scarps (location and size) ___ Yes X No

None observed

8. Major Erosion Problems (location and extent) ___ Yes X No

None observed

9. Water Impounding Against Toe ___ Yes X No

None Observed

10. Any appearance of instability, structural weakness or other hazardous conditions ___ Yes X No

None observed
Cool sunny day, slight breeze, temperature ≈ 31

LICENSED PROFESSIONAL ENGINEER No. 3345042202 JOHN D. BYARS STATE OF UTAH

John D. Byars P.E.
Registration No 3345042202
State of Utah

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..nter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

Canyon Fuel Company, LLC.
397 South 800 West
Salina, UT 84654

Report ID: S1301312001

Project: Sufco
Date Received: 1/25/2013

Date Reported: 2/14/2013
Work Order: S1301312

Lab ID	Sample ID	pH	Saturation	Electrical Conductivity	PE Calcium	PE Magnesium	PE Sodium	SAR	PE Alkalinity	Boron	Selenium
		s.u.	%	dS/m	meq/L	meq/L	meq/L		meq/L	ppm	ppm
S1301312-001	WRDS 1st Quarter	7.9	59.4	2.31	4.60	3.70	13.3	6.55	2.40	1.02	<0.02

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report
Canyon Fuel Company, LLC.
397 South 800 West
Salina, UT 84654

Report ID: S1301312001

Project: Sufco
Date Received: 1/25/2013

Date Reported: 2/14/2013
Work Order: S1301312

Lab ID	Sample ID	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t	Sulfate Sulfur %	Pyritic Sulfur %	Organic Sulfur %	PyriticS AB t/1000t	PyriticS ABP t/1000t
S1301312-001	WRDS 1st Quarter	0.37	11.6	91.2	79.5	<0.01	0.04	0.32	1.36	89.8

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Your Environmental Monitoring Partner

Soil Analysis Report

Canyon Fuel Company, LLC.
397 South 800 West
Salina, UT 84654

Report ID: S1305361001

Project: Quarterly Wasterock
Date Received: 5/22/2013

Date Reported: 6/11/2013
Work Order: S1305361

Lab ID	Sample ID	pH	Saturation	Electrical Conductivity	PE Calcium	PE Magnesium	PE Sodium	SAR	PE Alkalinity	Boron	Selenium
		s.u.	%	dS/m	meq/L	meq/L	meq/L		meq/L	ppm	ppm
S1305361-001	WRDS 2ND QUARTER	7.5	37.6	1.46	5.65	4.38	5.73	2.56	2.55	1.42	0.04

Received
JUN 25 2013
Canyon Fuel Company
SUFCO Mine

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

Canyon Fuel Company, LLC.

397 South 800 West
Salina, UT 84654

Report ID: S1305361001

Project: Quarterly Wasterock

Date Received: 5/22/2013

Date Reported: 6/11/2013

Work Order: S1305361

Lab ID	Sample ID	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t	Sulfate Sulfur %	Pyritic Sulfur %	Organic Sulfur %	PyriticS AB t/1000t	PyriticS ABP t/1000t
S1305361-001	WRDS 2ND QUARTER	0.35	10.8	114	103	0.02	0.12	0.21	3.78	110

Received
JUN 25 2013
Canyon Fuel Company
SUFCO Mine

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Your Environmental Monitoring Partner

Soil Analysis Report

Canyon Fuel Company, LLC.
397 South 800 West
Salina, UT 84654

Report ID: S1309013001

Project: Quarterly Wasterock
Date Received: 8/30/2013

Date Reported: 9/27/2013
Work Order: S1309013

Lab ID	Sample ID	pH s.u.	Saturation %	Electrical Conductivity dS/m	PE Calcium meq/L	PE Magnesium meq/L	PE Sodium meq/L	SAR	PE Alkalinity meq/L	Boron ppm	Selenium ppm
S1309013-001	WRDS 3RD QUARTER 2013	7.8	48.7	2.42	15.8	8.80	9.41	2.68	1.28	4.94	0.03

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Your Environmental Monit .g Partner

Soil Analysis Report
Canyon Fuel Company, LLC.
397 South 800 West
Salina, UT 84654

Report ID: S1309013001

Date Reported: 9/27/2013
Work Order: S1309013

Project: Quarterly Wasterock
Date Received: 8/30/2013

Lab ID	Sample ID	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t	Sulfate Sulfur %	Pyritic Sulfur %	Organic Sulfur %	PyriticS AB t/1000t	PyriticS ABP t/1000t
S1309013-001	WRDS 3RD QUARTER 2013	0.36	11.3	147	136	0.01	0.13	0.23	3.91	143

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Your Environmental Monitoring Partner

Soil Analysis Report

Canyon Fuel Company, LLC.
397 South 800 West
Salina, UT 84654

Report ID: S1311032001

Project: Quarterly Wasterock
Date Received: 11/4/2013

Date Reported: 12/4/2013
Work Order: S1311032

Lab ID	Sample ID	pH	Saturation	Electrical Conductivity	PE Calcium	PE Magnesium	PE Sodium	SAR	PE Alkalinity	Boron	Selenium
		s.u.	%	dS/m	meq/L	meq/L	meq/L		ppm	ppm	ppm
S1311032-001	WRDS 4TH QUARTER 2013	7.5	42.5	2.74	29.8	21.5	18.8	3.71	128	6.23	0.09

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

Canyon Fuel Company, LLC.
397 South 800 West
Salina, UT 84654

Report ID: S1311032001

Project: Quarterly Wasterock
Date Received: 11/4/2013

Date Reported: 12/4/2013
Work Order: S1311032

Lab ID	Sample ID	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t	Sulfate Sulfur %	Pyritic Sulfur %	Organic Sulfur %	PyriticS AB t/1000t	PyriticS ABP t/1000t
S1311032-001	WRDS 4TH QUARTER 2013	0.36	11.1	168	157	0.02	0.13	0.21	3.91	165

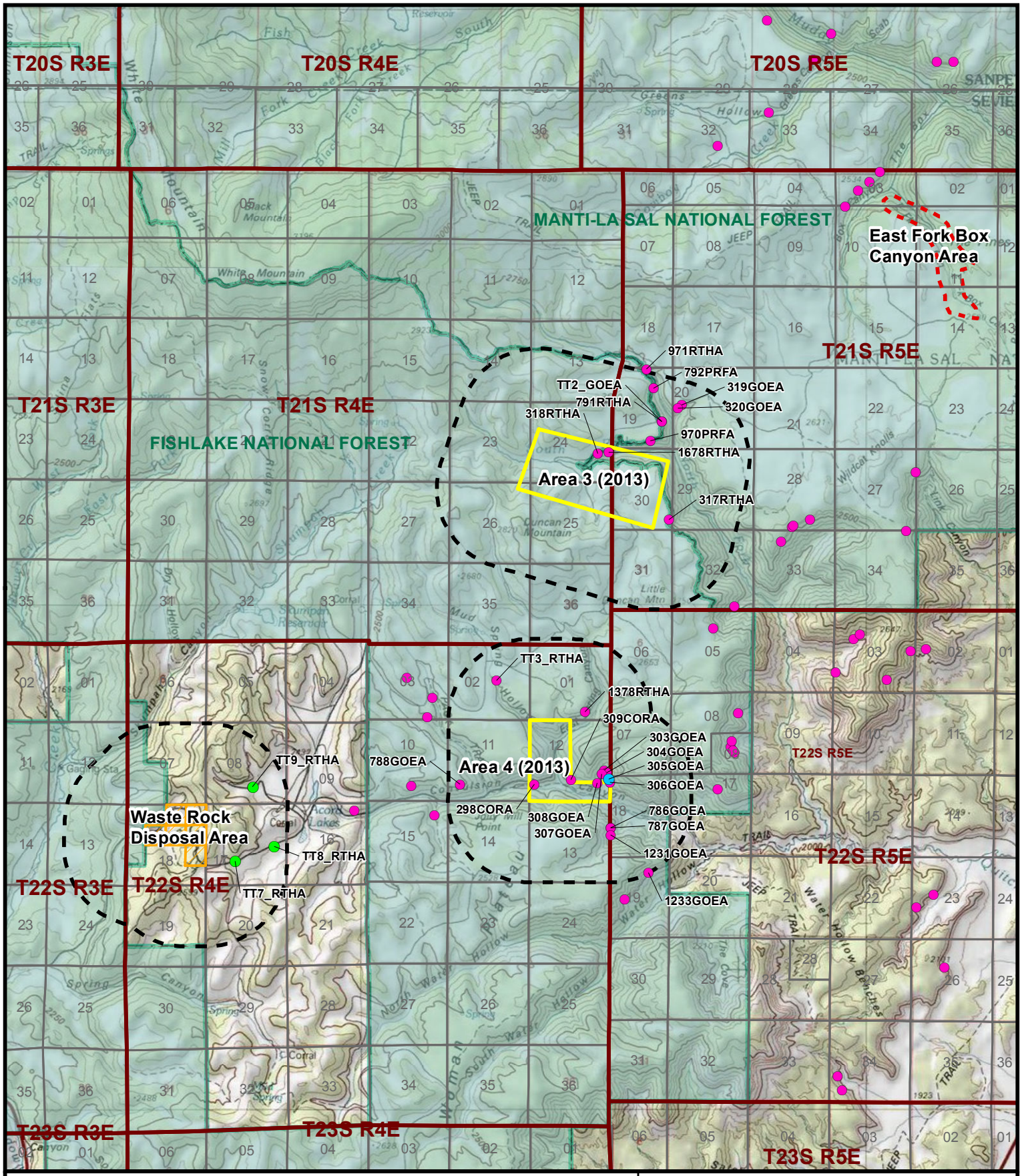
These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

WASTE ROCK DISPOSAL SITE

Year	Month	Month Tons Hauled		
2013	JAN	0		
2013	FEB	945		
2013	MAR	0		
2013	APR	1872		
2013	MAY	1116		
2013	JUN	0		
2013	JUL	0		
2013	AUG	432		
2013	SEP	1800		
2013	OCT	2673		
2013	NOV	1917		
2013	DEC	2754	**13,509**	**2013 Total Tons**



Legend

- New Raptor Nest - Active 2013
- Existing Raptor Nest - Active 2013
- Existing Raptor Nest - Inactive or Not Surveyed
- Waste Rock Disposal Area (Quarter-quarter sections)
- Study Areas 2013
- One-mile Buffer
- East Fork Box Canyon Area 2013
- Forest Service Land
- Non-Forest Service Land
- Section
- Township Range

N

0 1 2 Miles

CORA - Common Raven
GOEA - Golden eagle
PRFA - Prairie falcon
RTHA - Red-tailed hawk

FIGURE 1:
SUFCO Mine 2013 Raptor Surveys

Manti-La Sal and Fishlake National Forests, Sevier County, Utah

Sufco Mine
597 South SR 24
Salina, UT 84654

Date: 7/23/2013

TETRA TECH, INC.

Path: R:\A-G\Arch Coal_Ark Land Company\114-520145 - Sufco 2013 Subsidence\120- GIS\mxd\SUFCO_2013Subsid_Map_Regional_ForMemo.mxd

136 East South Temple, Suite 910
Salt Lake City Utah, 84111
Tel 801-364-1064 Fax 801-364-2021
www.tetratech.com

Technical Memorandum

To:	Vicky Miller	**From:**	Tetra Tech: Mike Egan, Project Manager Justin DeCaro, Wildlife Biologist James Hart, Wildlife Biologist
Company:	SUFCO Mine 597 South SR 24 Salina, UT 84654	**Date:**	07/23/2013
Re:	2013 Raptor Surveys	**Project:**	114-520145

Ms. Miller:

On behalf of Arch Coal's Sufco Mine (Sufco), Tetra Tech Inc. (Tetra Tech) conducted raptor surveys (raptor use and raptor nest inventories) on May 15, 16, 29, and 30, 2013 at the Sufco Mine in support of annual raptor monitoring requirements. The surveys were conducted in four areas (Area 3, Area 4, East Fork Box Canyon Area, and Waste Rock Disposal Area). **Figure 1** presents a topographical map showing the locations of each of the survey areas.

The Area 3, Area 4 and East Fork Box Canyon Area are located on land administered by the U.S. Department of Agriculture (USDA) Forest Service, Fishlake National Forest (FLNF) and Manti-La Sal National Forest (MLNF). The Waste Rock Disposal Area is located on private property surrounded by the FLNF. Area 3 and Area 4 are located within Sections 23, 24, 25 and 26, Township (T) 21 South (S), Range (R) 4 East (E); Section 30, T21S, R5E; and Section 12, T22S, R4E. The East Fork Box Canyon Area is located in Sections 3, 10, 11, and 14, T21S, R5E. The Waste Rock Disposal Area is located within Section 18, T22S, R4E (**Figure 1**).

SURVEY METHODS

Raptor Surveys

Raptor surveys were conducted following guidance from the 2010 State of Utah Department of Natural Resources, Division of Oil, Gas and Mining (DOGM) *Raptor Survey Guidelines* (DOGM 2010). All suitable nesting habitat identified in Area 3, Area 4, and the Waste Rock Disposal Area and accompanying one-mile buffer were surveyed. In addition, all suitable nesting habitat identified in the East Fork Box Canyon Area was also surveyed. All previously known nests in the survey areas were visited during the surveys to determine nesting activity. There are 25 previously known raptor nests that exist within the survey areas (**Figure 1**).

The location of any new raptor nests encountered during the surveys was recorded. Biologists also recorded any individual raptors that were observed while walking and driving throughout

the survey areas. Spotting scopes and binoculars were used to identify raptor species, verify the presence of nests (historic and new), and determine nest condition and activity.

Northern Goshawk Broadcast Vocalization and Intensive Search Surveys

Northern goshawk (*Accipiter gentilis*) broadcast vocalization surveys were conducted following the Forest Service protocol (Woodbridge and Hargis 2006). At each calling station, a northern goshawk alarm call was broadcast for 10 seconds, followed by 30 seconds of attentive listening and watching. Biologists would then repeat this sequence two more times, with 120 degrees of rotation between each call. Calls were broadcast on calm days no earlier than one-half hour before sunrise and no later than one-half hour after sunset.

An intensive search during travel between each call station was also conducted. This included listening for vocalizations and looking in mature trees for potential nesting sites. Biologists also inspected the ground for white wash, prey remains and feathers. The locations of any individuals encountered during the survey were recorded. Survey calling points were located within any suitable habitat within the survey areas at least 200 meters apart. The suitable habitat within the survey areas was surveyed two times, with visits at least seven days apart.

Incidental Observations

During travel throughout the survey areas, any occurrences of special status species of flora and fauna were recorded. This included migratory bird species and FLNF and MLNF management indicator species (i.e. elk (*Cervus canadensis*) calving, mule deer (*Odocoileus hemionus*) fawning, and greater sage-grouse (*Centrocercus urophasianus*). In addition, observations of other incidental wildlife species within the survey areas were also documented.

RESULTS: HABITAT ASSESSMENT

Habitat within Area 3, Area 4, and the Waste Rock Disposal Area consists primarily of sagebrush (*Artemisia tridentata*) shrublands, mountain shrub, and small stands of conifer and aspen (*Populus tremuloides*). The Waste Rock Disposal Area contains small patches of mixed conifer and aspen, intermixed with the sagebrush and mountain brush species. The habitat in the East Fork Box Canyon Area consists primarily of ponderosa pine (*Pinus ponderosa*), aspen and mixed shrublands. The Waste Rock Disposal Area is much lower in elevation than the other survey areas.

RESULTS: SURVEY RESULTS

The weather on May 15 and 16, 2013 was around 60 degrees Fahrenheit, with partly cloudy/cloudy skies, and variable winds of zero to 10 miles per hour (mph). Weather during the second visit on May 29 and 30, 2013 was between 55 and 65 degrees Fahrenheit, with partly cloudy skies and no winds.

Raptor Survey Results

There were four active raptor nests in the 2013 survey area, of which three were new nests. The three new raptor nests (TT7_RTHA, TT8_RTHA, and TT9_RTHA) were all occupied by red-tailed hawks (*Buteo jamaicensis*). All three of the new nests were located within the one-mile buffer of the Waste Rock Disposal Area and all were on private property (**Figure 1**). Observations of these nests were made from a distance using binoculars and a spotting scope; therefore, the coordinates are estimated. According to DOGM (2010), the spatial buffer for red-tailed hawks is 0.5-mile. Only nest TT7_RTHA was within 0.5 mile of the Waste Rock Disposal

Area. All three nests were located in aspen trees (the aspen tree where TT8_RTHA was located was a snag). During the first survey, all three nests were occupied by incubating female red-tailed hawks (see attached **Field Photos**). During the second survey, these nests were checked again to determine productivity. Nest TT9_RTHA had two nestlings. Nests TT7_RTHA and TT8_RTHA still had incubating females.

Of the 25 previously known nests that were surveyed, only one golden eagle nest (305GOEA) was active. This nest is located in Convulsion Canyon within 250 feet of the Area 4 boundary. During the first survey, the nest had one nestling and during the second survey there was still one nestling that appeared to be close to fledging (see attached **Field Photos**).

Two other raptor species were observed flying through the survey areas. During the first survey, a Cooper's hawk (*Accipiter cooperii*) and a prairie falcon (*Falco mexicanus*) were observed near the Waste Rock Disposal Area. During the second survey, no other raptors were observed.

Northern Goshawk Survey Results

The ability to detect northern goshawk and other raptor nests was excellent because the aspen trees had not leafed out yet. No northern goshawks or northern goshawk nests were detected within the survey areas. The habitat in the survey areas is not optimal for goshawk nesting due to the lack of expansive, mature stands of timber. According to the Forest Service, northern goshawks are known to use the Box Canyon area in late winter/early spring, but are thought to move to higher elevations later in the season where more suitable mixed-conifer habitat exists. The Forest Service has done extensive nest searches in this area in the past, but no nests have ever been observed.

Incidental Observations

No special status species of flora and fauna, including FLNF and MLNF management indicator species (i.e., elk calving, mule deer fawning and greater sage-grouse breeding/nesting) were observed within the survey areas. One mule deer was observed during the first survey near the East Fork Box Canyon Area. **Table 1** lists migratory bird species observed within the survey areas during the May 2013 surveys.

If you have any questions regarding this memo, please contact Mike Egan at 801-364-1064 extension 203.

Sincerely,
Tetra Tech, Inc.

Michael M. Egan

Michael Egan
Sr. Project Manager

Attachments: **Figure 1**
Table 1
Field Photos

REFERENCES

Division of Oil, Gas and Mining (DOGM). 2010. *Raptor Survey Guidelines.* March, 2010. 23 pp.

Woodbridge, B. and C.D. Hargis. 2006. *Northern Goshawk Inventory and Monitoring Technical Guide*. Gen. Tech. Rep. WO-71. Washington, DC: U.S. Department of Agriculture, Forest Service. 80 pp.

Table 1: Migratory Bird Species Observed Within the Sufco 2013 Raptor Survey Areas, May 2013

American Robin *(Turdus migratorius)*
Black-billed Magpie (*Pica hudsonia*)
Black-capped Chickadee (*Poecile atricapillus*)
Brewer's Sparrow (*Spizella breweri*)
Cassin's Finch (*Carpodacus cassinii*)
Chipping Sparrow (*Spizella passerine*)
Clark's Nutcracker (*Nucifraga columbiana*)
Common Raven (*Corvus corax*)
Cooper's Hawk (*Accipiter cooperii*)
Dark-eyed Junco (*Junco hyemalis*)
Downy Woodpecker (*Picoides pubescens*)
Dusky Flycatcher **(***Empidonax oberholseri*)
Golden Eagle (*Aquila chrysaetos*)
Hairy Woodpecker (*Picoides villosus*)
Hermit Thrush (*Catharus guttatus*)
Mountain Bluebird (*Sialia currucoides*)
Mountain Chickadee (*Poecile gambeli*)
Mourning Dove (*Zenaida macroura*)
Northern Flicker (*Colaptes auratus)*
Pine Siskin (*Spinus pinus*)
Prairie Falcon (*Falco mexicanus*)
Red-breasted Nuthatch (*Sitta canadensis*)
Red-tailed Hawk (*Buteo jamaicensis*)
Rock Wren (*Salpinctes obsoletus*)
Ruby-crowned Kinglet (*Regulus calendula)*
Stellar's Jay (*Cyanocitta stelleri*)
Townsend's Solitaire (*Myadestes townsendi*)
Violet-green Swallow (*Tachycineta thalassina*)
Western Bluebird (*Sialia mexicana*)
Western Wood-pewee (*Contopus sordidulus*)
Yellow-rumped Warbler (*Dendroica coronata*)

Field Photos

TT7_RTHA Red-tailed Hawk Active Nest – First Survey.

TT8_RTHA Red-tailed Hawk Active Nest – First Survey.

TT9_RTHA Red-tailed Hawk Active Nest – First Survey.

305 Golden Eagle Active Nest – First Survey

305 Golden Eagle Active Nest – Second Survey

RIPARIAN PLANT COMMUNITY MONITORING IN SELECTED REACHES: SOUTH FORK QUITCHUPAH CREEK

July & October

2013

FOR THE

SUFCO MINE

SEVIER COUNTY, UTAH

Prepared by

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Introduction

The SUFCO Coal Mine has expanded their underground operations near and below some reaches of the South Fork Quitchupah Creek. The riparian plant communities supported along the creek have been and will continue to be monitored for possible impacts that could be caused by mine-related subsidence. These studies are conducted before, during, and after the mining takes place. This document includes the results of quantitative and qualitative vegetation sampling in several locations within and outside the subsidence zones. The results include two sample periods in 2013 – July and October. Two additional sample stations were added to the October sample period.

The Study Areas

The South Fork Quitchupah Creek study area is located at the southern end of the Wasatch Plateau, a subprovince of the Colorado Plateau physiographic province. It also lies within Sevier County, Utah west of the town of Emery, and is located within the boundaries of the USDA National Forest property. Quitchupah Creek and its forks are tributaries to Muddy Creek which converges with the Dirty Devil River and ultimately drains into the Colorado River. Elevations of the sample stations fall between 7,700 ft and 8,400 ft above sea level. Geology of the study area is within the Cretaceous strata of the Mesa Verde Group. The upper sample sites lie below the North Horn Formation and are within the Price River Formation. The next lower sites are near the contact zone between the Price River Formation and the cliff-forming Castlegate Sandstone. Continuing downstream there is one site that is located at the contact between Castlegate Sandstone and the Blackhawk Formation. Finally, the lowest site was established in the Blackhawk Formation.

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 vegetation to provide baseline and followup data by monitoring the riparian communities adjacent to South Fork Quitchupah Creek. Regular monitoring will be conducted to 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 and nearby springs.

To be consistent with other riparian studies for the mine, this study primarily employed vegetation monitoring methods described by the USDA Forest Service (described later). The design of this study was not to 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 make year-to-year comparisons 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 Placement

A field visit to the site was initially conducted by a team of representatives from the SUFCO Mine, USDA Forest Service, Bureau of Land Management, Utah Division of Water Rights and Utah Division of Oil, Gas & Mining, Petersen Hydrologic and Mt. Nebo Scientific. The study area was delineated at that time. The general zones for the future subsidence and areas adjacent to them were visited. Potential sample locations for vegetation and water quality were addressed by the team in the field. The final sample locations were chosen later, some of them beyond subsidence zones with the idea that those areas could be used in the future as "controls", or areas that will *not* be impacted by mining-related subsidence, and can be used to compare those areas that may have been impacted.

Qualitative and quantitative data were recorded at the sample stations along South Fork Quitchupah Creek. Line transects were placed at the stations. Locations and extent of the transects were semi-permanently marked using numbered and flagged wooden stakes and 12-inch metal rods. GPS coordinates were recorded at the stations. With some modifications, the vegetation monitoring methods of the studies were based on those described by the USDA Forest Service manual for a "*Level III Riparian Area Evaluation*" (*Integrated Riparian Evaluation Guide*, March 1992).

Geomorphological stream channel data outlined in the Forest Service protocol were not recorded as part of this study because scientists for the SUFCO Mine have conducted other studies that will suffice for that information. Additionally, soils information through the Natural Resources Conservation Service (NRCS) was not available for the study area.

Qualitative Data

The *RIPARIAN COMPLEX DATA SHEET* shown on Table 1 lists the qualitative and quantitative data that have been, and will continue to be, collected at each sample station.

Photographic stations for documentation and future comparisons have also been established at each sample location. A sample location map has been included in this report.

Quantitative Data

As mentioned, USDA Forest Service protocol was employed as a model to drive the study plan for data collection. *Community Type Cover* is one method to record cover in the Forest Service Level III protocol. At the sample locations, transect lines have been placed across (or perpendicular to) the stream channel. By design, the line transects vary in lengths which are based on several factors. Although sometimes limited by

TABLE 1: RIPARIAN COMPLEX DATA SHEET

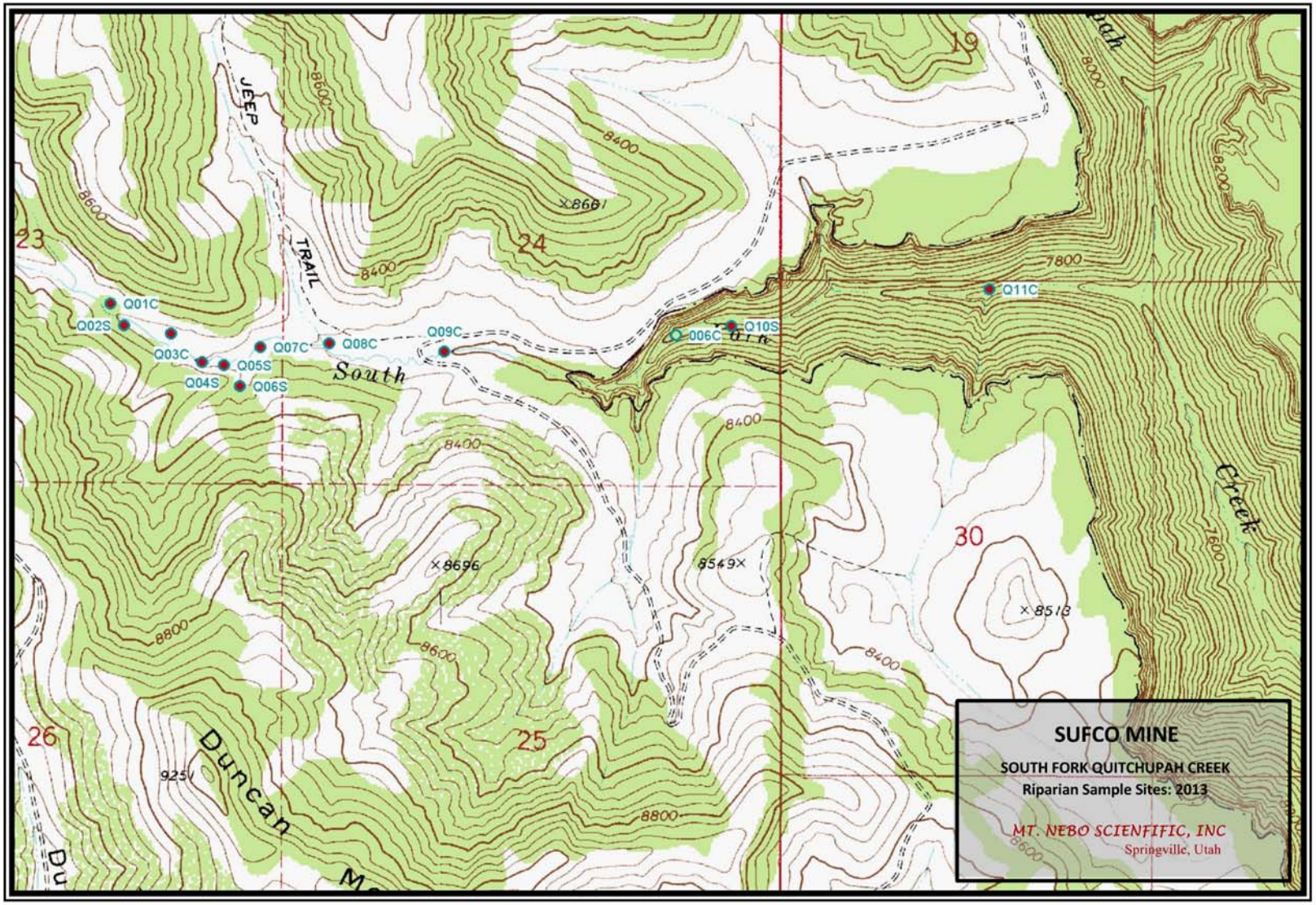
CLIENT:
SAMPLE NUMBER:
WATERBODY NAME:
LOCATION:
DATE:
OBSERVER(S):
QUAD NAME:
GEOLOGIC PARENT MATERIAL:
STREAM ASPECT:
STREAM GRADIENT:
ELEVATION: .
SIZE OF COMPLEX:
ADJACENT UPLAND VEGETATION (looking downstream)
Left: Right:
VEGETATIVE DESCRIPTION (Dominance by Community Types)
COMMUNITY SUCCESSIONAL STAGE:
APPARENT FORAGE TREND:
ESTIMATED FORAGE PRODUCTION:
BEAVER ACTIVITY:
EROSION RATING:
PHOTOGRAPH TAKEN:
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:
NOTES:
QUANTITATIVE DATA SUMMARY:
PHOTOGRAPHIC DOCUMENTATION:

topographical features, 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 data should provide information about possible increases or decreases in the riparian communities relative to the adjacent upland communities.

Once the transects were placed, the line-intercept method was employed to measure the extent of each major riparian plant community. The plant communities have been 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. When appropriate, community data have been separated on the right and left side of the creek – these references mean "river-left" and "river-right", *as characterized by looking downstream*. Because there were no well defined creek channels within the transect lines of the springs, the riparian/wetland vegetation data were not separated in this manner. Finally, each sample site was numbered sequentially and by the hydrologic type. For example, **Q01C** refers to the creek name (Quitchupah), station number (01), hydrologic type (channel). Accordingly, **Q02S** is a spring site rather than a creek channel.

Results

A map showing the sample station locations is shown on the following page. Sample results are shown for each site on the data sheets provided in this report. Each sheet includes qualitative and quantitative data recorded as well as photographic documentation.


SUFCO MINE
SOUTH FORK QUITCHUPAH CREEK
Riparian Sample Sites: 2013
MT. NEBO SCIENFIFIC, INC
Springville, Utah
Q01C
Q02S
Q03C
Q04S
Q05S
Q06S
Q07C
Q08C
Q09C
Q006C
Q10S
Q11C
JEEP
TRAIL
South
Fork
Duncan
Creek
23
24
25
26
30
19
8600
8400
8800
8200
8000
7800
7600
8661
8696
8549
8518
9251

SECTION A

RIPARIAN COMPLEX DATA SHEETS

for the

JULY 2013 SAMPLE PERIOD

RIPARIAN COMPLEX DATA SHEET
July 2013

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: ***Q01C***

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: Southern Wasatch Plateau, Utah

DATE: *July 24-25, 2013*

OBSERVER(S): *P. Collins*

USGS QUAD 7.5 MINUTE MAP: *Acord Lakes, Utah*

GEOLOGIC PARENT MATERIAL: *Price River Formation*

STREAM ASPECT: *East (120°)*

STREAM GRADIENT: *1-2°*

ELEVATION: *8,335 ft*

SIZE OF COMPLEX: *(see quantitative data)*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: *Snowberry/Sagebrush/Grass* Right: *Aspen*

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

COMMUNITY SUCCESSIONAL STAGE: *Mid (tree saplings present)*

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *500 lbs/acre*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=slight; 5=extreme): *3*

PHOTOGRAPH TAKEN: *Yes*

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: *Mining, grazing, hunting, cattle, wildlife and recreation.*

SPECIES OBSERVED:

Trees	**Shrubs**	**Forbs**	**Grasses (or grasslike)**
Populus tremuloides	*Artemisia tridentata*	*Achillea millefolium*	*Juncus arcticus*
Salix boothii	*Rosa woodsii*	*Taraxacum officinale*	*Poa pratensis*
	Symphoricarpos oreophilus		

POOL ATTRIBUTES

% area in pools: *0*

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

AQUATIC VEGETATION

% streambed with filamentous algae: *50 (left)*

% stream margin with rooted aquatic: *0*

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90º): *0*

% bank length gently sloping (>135º): *0*

% bank length with overhanging vegetation: *25 (short Booth's willows)*

BANK CONDITION

% bank length vegetated, stable: *80*

% bank length unvegetated, stable: *10*

% bank length vegetated, unstable: *0*

% bank length unvegetated, unstable: *10*

NOTES:

1) This is a good creek channel monitoring site. It is outside the cattle trail and readily monitored.
2) Probably a good "control" site (outside the subsidence zone).
3) There was quite a bit of cattle use noticed this sample period.

DATA SUMMARY

Q01C: Cover by plant community types in the South Fork Quitchupah Creek drainage (July 2013).

USDA Forest Service Protocol (1992)

	LEFT	RIGHT	TOTALS
UPLAND VEGETATION			
Symphoricarpos oreophilus/Artemisia tridentata/Poa pratensis	9.50		
Poa pratensis/Taraxacum officinale		10.00	19.50
RIPARIAN VEGETATION			
Dominant Woody Species			
Salix boothii	0.50		
Dominant Herbaceous Species			
Juncus arcticus/Rosa woodsii	3.50		
Carex nebrascensis/Juncus arcticus		5.00	9.00
TOTAL COVER (Upland Species)			19.50
TOTAL COVER (Riparian Species)			9.00
ROCK (channel)			0.00
WATER (channel)			1.50
BAREGROUND (channel)			0.00
LITTER			0.00
MOSS			0.00
TOTAL COVER			30.00

PHOTOGRAPHIC DOCUMENTATION

Q01C

RIPARIAN COMPLEX DATA SHEET
July 2013

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: ***Q025***

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: Southern Wasatch Plateau, Utah

DATE: *July 24-25, 2013*

OBSERVER(S): *P. Collins*

USGS QUAD 7.5 MINUTE MAP: *Acord Lakes, Utah*

GEOLOGIC PARENT MATERIAL: *Price River Formation*

STREAM ASPECT: *E; Flow is NE (50°)*

STREAM GRADIENT: *1-2°*

ELEVATION: *8,330 ft*

SIZE OF COMPLEX: *(see quantitative data)*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: *Aspen* Right: *Aspen*

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

COMMUNITY SUCCESSIONAL STAGE: *Mid*

APPARENT FORAGE TREND: *Decreasing (ground cover was mud and vegetation)*

ESTIMATED FORAGE PRODUCTION: *300 lbs/acre*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *Inside of spring =3; outside=4.*

PHOTOGRAPH TAKEN: *Yes*

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: *Mining, grazing (cattle & wildlife), hunting, recreation.*

SPECIES OBSERVED:

Trees	**Shrubs**	**Forbs**	**Grasses (or grasslike)**
Picea pungens	*Ribes sp.*	*Achillea millefolium*	*Agrostis stolonifera*
Populus tremuloides	*Symphoricarpos oreophilus*	*Equisetum arvense*	*Carex nebrascensis*
		Ranunculus cymbalaria	*Poa pratensis*
		Taraxacum officinale	

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 (<90º): *0*

% bank length gently sloping (>135º): *100*

% bank length with overhanging vegetation: *0*

BANK CONDITION	Center	Side
% bank length vegetated, stable:	*35*	*60*
% bank length unvegetated, stable:	*15*	*20*
% bank length vegetated, unstable:	*30*	*5*
% bank length unvegetated, unstable:	*20*	*15*

NOTES:

1) This is a spring area.
2) Probably a good "control" site (outside the subsidence zone).
3) There were lots of cattle hoof-prints (disturbance).
4) The Bank Condition represents both the bank and wet areas (refer to the photograph).
5) The center of the spring was comprised of about ½ water and ½ mud.

DATA SUMMARY

Q02S: Cover by plant community types in the South Fork Quitchupah Creek drainage (July 2013).

USDA Forest Service Protocol (1992)

	LEFT	RIGHT	TOTALS
UPLAND VEGETATION			
Poa pratensis/Achillea millefolium	10.00		
Geranium richardsonii/Poa pratensis		8.00	
			18.00
RIPARIAN VEGETATION			
Dominant Woody Species			
Dominant Herbaceous Species			
Ranunculus cymbalaria/Agrostis stolonifera		6.00	
Carex nebrascensis/Ranunculus cymbalaria	1.00		
			7.00
TOTAL COVER (Upland Species)			18.00
TOTAL COVER (Riparian Species)			7.00
ROCK (channel)			0.00
WATER (channel)			4.00
BAREGROUND (channel)			4.00
LITTER			0.00
MOSS			0.00
TOTAL COVER			33.00

PHOTOGRAPHIC DOCUMENTATION

Q02S

RIPARIAN COMPLEX DATA SHEET
July 2013

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: ***Q03C***

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: Southern Wasatch Plateau, Utah

DATE: *July 24-25, 2013*

OBSERVER(S): *P. Collins*

USGS QUAD 7.5 MINUTE MAP: *Acord Lakes, Utah*

GEOLOGIC PARENT MATERIAL: *Price River Formation*

STREAM ASPECT: *E (90°)*

STREAM GRADIENT: *1-2°*

ELEVATION: *8,310 ft*

SIZE OF COMPLEX: *(see quantitative data)*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: *Sagebrush/Grass* Right: *Aspen*

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

COMMUNITY SUCCESSIONAL STAGE: *Mid (tree saplings present)*

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *800 lbs/acre*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *3 (on river bank near the water).*

PHOTOGRAPH TAKEN: *Yes*

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: *Mining, grazing (cattle & wildlife), hunting, recreation.*

SPECIES OBSERVED:

Trees	**Shrubs**	**Forbs**	**Grasses (or grasslike)**
Populus tremuloides	*Artemisia tridentata*	*Aster sp.*	*Agrostis stolonifera*
	Rosa woodsii	*Equisetum arvense*	*Juncus arcticus*
	Salix spp.	*Taraxacum officinale*	*Juncus longistylis*

POOL ATTRIBUTES

% area in pools: *0*

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

AQUATIC VEGETATION

% streambed with filamentous algae: *0*

% stream margin with rooted aquatic: *0*

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *50 on rt side; 100 lf side just above water level. The water level may dictate different results here.*

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

% bank length with overhanging vegetation: *0*

BANK CONDITION

% bank length vegetated, stable: *90*

% bank length unvegetated, stable: *2.5*

% bank length vegetated, unstable: *2.5*

% bank length unvegetated, unstable: *5*

NOTES:

1) This is a channel site.
2) A good control station; outside current subsidence plans.
3) It seems like we needed a sample here, but this may be more difficult to monitor as accurately due to the topography. The narrow channel sites are more straight-forward to monitor than this type.
4) Interestingly, the adjacent aspen understory (that I considered upland) had more wiregrass present. This may be a function of the shade prolonging snowmelt.
5) This wiregrass area should be noted during each sample period.
6) Therefore on the right side, it is difficult to separate the upland from the riparian.

DATA SUMMARY

Q03C: Cover by plant community types in the South Fork Quitchupah Creek drainage (July 2013).

USDA Forest Service Protocol (1992)

	LEFT	RIGHT	TOTALS
UPLAND VEGETATION			
Artemisia tridentata/Elymus salinus	10.00		
Populus tremuloides/Juncus arcticus		13.00	
			23.00
RIPARIAN VEGETATION			
Dominant Woody Species			
Dominant Herbaceous Species			
Juncus arcticus	6.50	4.00	
			10.50
TOTAL COVER (Upland Species)			23.00
TOTAL COVER (Riparian Species)			10.50
ROCK (channel)			0.00
WATER (channel)			1.50
BAREGROUND (channel)			0.00
LITTER			0.00
MOSS			0.00
TOTAL COVER			35.00

PHOTOGRAPHIC DOCUMENTATION

Q03C

RIPARIAN COMPLEX DATA SHEET
July 2013

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: ***Q045***

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: Southern Wasatch Plateau, Utah

DATE: *July 24-25, 2013*

OBSERVER(S): *P. Collins*

USGS QUAD 7.5 MINUTE MAP: *Acord Lakes, Utah*

GEOLOGIC PARENT MATERIAL: *Price River Formation*

STREAM ASPECT: *E [but flow here was N (340°)*]

STREAM GRADIENT: *1-2°*

ELEVATION: *8,310 ft*

SIZE OF COMPLEX: *(see quantitative data)*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: *Aspen* Right: *Aspen/Blue Spruce/Willow*

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

COMMUNITY SUCCESSIONAL STAGE: *Late*

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *700 lbs/acre*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *3*

PHOTOGRAPH TAKEN: *Yes*

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: *Mining, grazing (cattle & wildlife), hunting, recreation.*

SPECIES OBSERVED:

Trees	**Shrubs**	**Forbs**	**Grasses (or grasslike)**
Picea pungens	*Rosa woodsii*	*Achillea millefolium*	*Eleocharis palustris*
Populus tremuloides	*Salix boothii*	*Equisetum arvense*	*Hordeum jubatum*
		Geranium richardsonii	*Juncus arcticus*
			Juncus longistylis
			Poa pratensis

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°): *100*

% bank length with overhanging vegetation: *50*

BANK CONDITION

% bank length vegetated, stable: *55*

% bank length unvegetated, stable: *0*

% bank length vegetated, unstable: *15*

% bank length unvegetated, unstable: *30*

NOTES:

1) This is a spring area.

2) It is a good control station; outside current subsidence plans.

3) The spring was mostly dry in July 2013. There was a 7 ft diameter area of mud in the middle where it had received heavy cattle pressure.

4) The spring site had several zones of vegetation based on the different water regimes.

5) Nebraska sedge and spike rush zones seemed to be the wettest areas.

6) There was a lot of impact from cattle trampling here. Because of this some areas had a high living cover value, whereas other areas were low.

7) There was almost no water this period - about 4 hoof prints had some water in them.

DATA SUMMARY

Q04S: Cover by plant community types in the South Fork Quitchupah Creek drainage (July 2013).

USDA Forest Service Protocol (1992)

	LEFT	RIGHT	TOTALS
UPLAND VEGETATION			
Symphoricarpos oreophilus/Populus tremuloides	9.00		
Picea pungens/Salix boothii		10.00	
			19.00
RIPARIAN VEGETATION			
Dominant Woody Species			
Dominant Herbaceous Species			
Carex nebrascensis/Hordeum jubatum			
Eleocharis palustris/Ranunculus cymbalaria		25.00	
Carex nebrascensis	8.00		
			33.00
TOTAL COVER (Upland Species)			19.00
TOTAL COVER (Riparian Species)			33.00
ROCK (channel)			0.00
WATER (channel)			4.00
BAREGROUND (channel)			0.00
LITTER			0.00
MOSS			0.00
TOTAL COVER			56.00

PHOTOGRAPHIC DOCUMENTATION

Q04S

RIPARIAN COMPLEX DATA SHEET
July 2013

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: ***Q055***

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: Southern Wasatch Plateau, Utah

DATE: *July 24-25, 2013*

OBSERVER(S): *P. Collins*

USGS QUAD 7.5 MINUTE MAP: *Acord Lakes, Utah*

GEOLOGIC PARENT MATERIAL: *Price River Formation*

STREAM ASPECT: *E; flow here was 30°*

STREAM GRADIENT: *1-2°*

ELEVATION: *8,294 ft*

SIZE OF COMPLEX: *(see quantitative data)*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: *Blue Spruce/Willow* Right: *Blue Spruce/Aspen*

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

COMMUNITY SUCCESSIONAL STAGE: *Late*

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *700 lbs/acre*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *4 (due to cattle)*

PHOTOGRAPH TAKEN: *Yes*

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: *Mining, grazing (cattle & wildlife), hunting, recreation.*

SPECIES OBSERVED:

Trees	**Shrubs**	**Forbs**	**Grasses (or grasslike)**
Picea pungens	*Salix boothii*	*Equisetum arvense*	*Agrostis stolonifera*
Pinus flexilis	*Symphoricarpos oreophilus*	*Geranium richardsonii*	*Carex nebrascensis*
Populus tremuloides		*Ranunculus cymbalaria*	

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: *20*

BANK CONDITION

% bank length vegetated, stable: *55*

% bank length unvegetated, stable: *5*

% bank length vegetated, unstable: *20 (due to cattle)*

% bank length unvegetated, unstable: *20*

NOTES:

1) This is a well-defined spring area.
2) A good control station; it is just outside current subsidence plans.
3) When I placed the transect tape, it formed a "U" shape to measure. This tape was placed 4 ft from the upland bank for 72 ft of riparian/spring vegetation.
4) For this sample period, the water area comprised the entire 38 ft out of the 72 ft mentioned above.
5) There was a lot of impact from cattle trampling at the site.
6) There was vegetation and mud present in the spring at the transect line (no water).

DATA SUMMARY

Q05S: Cover by plant community types in the South Fork Quitchupah Creek drainage (July 2013).

USDA Forest Service Protocol (1992)

	LEFT	RIGHT	TOTALS
UPLAND VEGETATION			
Salix boothii/Picea pungens	10.00		
Picea pungens/Populus tremuloides		11.00	
			21.00
RIPARIAN VEGETATION			
Dominant Woody Species			
Dominant Herbaceous Species			
Carex nebrascensis/Agrostis stolonifera/Ranunculus cymbalaria	36.00	36.00	
			72.00
TOTAL COVER (Upland Species)			21.00
TOTAL COVER (Riparian Species)			72.00
ROCK (channel)			0.00
WATER (channel)			0.00
BAREGROUND (channel)			0.00
LITTER			0.00
MOSS			0.00
TOTAL COVER			93.00

PHOTOGRAPHIC DOCUMENTATION

Q05S

RIPARIAN COMPLEX DATA SHEET
July 2013

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: ***Q06S***

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: Southern Wasatch Plateau, Utah

DATE: *July 24-25, 2013*

OBSERVER(S): *P. Collins*

USGS QUAD 7.5 MINUTE MAP: *Acord Lakes, Utah*

GEOLOGIC PARENT MATERIAL: *Price River Formation*

STREAM ASPECT: *E [but flow here was N (330°)*]

STREAM GRADIENT: *1-2°*

ELEVATION: *8,313 ft*

SIZE OF COMPLEX: *(see quantitative data)*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: *Meadow* Right: *Meadow*

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

COMMUNITY SUCCESSIONAL STAGE: *Late*

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *300 lbs/acre*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *4 (cattle impact)*

PHOTOGRAPH TAKEN: *Yes*

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: *Mining, grazing (cattle & wildlife), hunting, recreation.*

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Populus tremuloides	*Ribes sp*	*Equisetum arvense*	*Agrostis stolonifera*
	Salix boothii	*Taraxacum officinale*	*Poa pratensis*

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°): *100*

% bank length with overhanging vegetation: *25*

BANK CONDITION

% bank length vegetated, stable: *15*

% bank length unvegetated, stable: *0*

% bank length vegetated, unstable: *10*

% bank length unvegetated, unstable: *75 (cattle impact)*

NOTES:

1) Only measured obvious, well-defined spring area.
2) Left side measured to bank (3 ft).
3) Cattle had a great impact for this sample period. Therefore the riparian vegetation was almost all located on the sides of the spring channel (see photo).
4) Riparian/wetland vegetation was measured in the spring channel only.
5) There was 7 ft in the center of the spring with water in hoof prints (<10% cover here).
6) The sample station was located within current planned subsidence zone.

DATA SUMMARY

Q06S: Cover by plant community types in the South Fork Quitchupah Creek drainage (July 2013).

USDA Forest Service Protocol (1992)

	LEFT	RIGHT	TOTALS
UPLAND VEGETATION			
Populus tremuloides/Salix boothii	3.00		
Symphoricarpos oreophilus/Grasses		5.00	
			8.00
RIPARIAN VEGETATION			
Dominant Woody Species			
Dominant Herbaceous Species			
Agrostis stolonifera	2.50	2.50	5.00
TOTAL COVER (Upland Species)			8.00
TOTAL COVER (Riparian Species)			5.00
ROCK (channel)			0.00
WATER (channel)			0.00
BAREGROUND (channel)			7.00
LITTER			0.00
MOSS			0.00
TOTAL COVER			20.00

PHOTOGRAPHIC DOCUMENTATION

Q06S

RIPARIAN COMPLEX DATA SHEET
July 2013

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: ***Q07C***

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: Southern Wasatch Plateau, Utah

DATE: *July 24-25, 2013*

OBSERVER(S): *P. Collins*

USGS QUAD 7.5 MINUTE MAP: *Acord Lakes, Utah*

GEOLOGIC PARENT MATERIAL: *Price River Formation*

STREAM ASPECT: *E [but flow here was N (5°)*]

STREAM GRADIENT: *2-3°*

ELEVATION: *8,285 ft*

SIZE OF COMPLEX: *(see quantitative data)*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: *Meadow* Right: *Meadow*

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

COMMUNITY SUCCESSIONAL STAGE: *Mid-*

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *1,100 lbs/acre*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *1*

PHOTOGRAPH TAKEN: *Yes*

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: *Mining, grazing (cattle & wildlife), hunting, recreation.*

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
	Rosa woodsii	*Achillea millefolium*	*Agrostis stolonifera*
	Salix boothii	*Trifolium sp.*	*Carex nebrascensis*
			Hordeum jubatum
			Poa pratensis

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°): *50 (all on right side)*

% bank length gently sloping (>135°): *100 incised (18") channel*

% bank length with overhanging vegetation:

BANK CONDITION

% bank length vegetated, stable: *95*

% bank length unvegetated, stable: *2.5*

% bank length vegetated, unstable: *0*

% bank length unvegetated, unstable: *2.5*

NOTES:

1) This site is in the middle of a meadow.
2) Right side: This area looked different than the last sample period. This side had little upland vegetation (some foxtail barley). It was mostly all riparian vegetation with more Nebraska sedge this period. I think these communities are dynamic and can show year-to-year differences based on water regimes. For example, I think in the dryer years different species are more prominent for cover and production and the same for the wetter years. There may also be variations from season to season. I am sampling somewhat earlier this year compared to 2012.
3) Left side: The riparian community was measured beginning in the meadow (where the stake would be easily found later) and ended at the channel bank. The entire meadow, however, had some wetland species.

4) This site is within the current planned subsidence zone.
5) There was cattle at the site when I was sampling

DATA SUMMARY

Q07C: Cover by plant community types in the South Fork Quitchupah Creek drainage (July 2013).

USDA Forest Service Protocol (1992)

	LEFT	RIGHT	TOTALS
UPLAND VEGETATION	0.00		
Poa pratensis/Achillea millefolium		0.00	
Poa pratensis/Achillea millefolium			0.00
RIPARIAN VEGETATION			
Dominant Woody Species			
Rosa woodsii	7.50		
Dominant Herbaceous Species			
Carex nebrascensis/Poa pratensis		10.50	
Carex nebrascensis	24.00	10.00	
Juncus arcticus	2.00		33.50
TOTAL COVER (Upland Species)			0.00
TOTAL COVER (Riparian Species)			54.00
ROCK (channel)			0.00
WATER (channel)			1.00
BAREGROUND (channel)			0.00
LITTER			0.00
MOSS			0.00
TOTAL COVER			55.00

PHOTOGRAPHIC DOCUMENTATION

Q07C

RIPARIAN COMPLEX DATA SHEET
July 2013

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: ***Q08C***

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: Southern Wasatch Plateau, Utah

DATE: *July 24-25, 2013*

OBSERVER(S): *P. Collins*

USGS QUAD 7.5 MINUTE MAP: *Acord Lakes, Utah*

GEOLOGIC PARENT MATERIAL: *Price River Formation*

STREAM ASPECT: *E (flow here was 140°)*

STREAM GRADIENT: *2-3°*

ELEVATION: *8,253 ft*

SIZE OF COMPLEX: *(see quantitative data)*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: *Sagebrush/Grass* Right: *Aspen/Snowberry*

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

COMMUNITY SUCCESSIONAL STAGE: *Mid*

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *1,000 lbs/acre*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *1 (banks)*

PHOTOGRAPH TAKEN: *Yes*

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: *Mining, grazing (cattle & wildlife), hunting, recreation.*

SPECIES OBSERVED:

Trees	**Shrubs**	**Forbs**	**Grasses (or grasslike)**
Populus tremuloides	*Artemisia tridentata*	*Trifolium sp.*	*Agrostis stolonifera*
	Salix boothii		*Carex nebrascensis*
			Juncus arcticus

POOL ATTRIBUTES

% area in pools: *0*

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

AQUATIC VEGETATION

% streambed with filamentous algae: *0*

% stream margin with rooted aquatic: *0*

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*

% bank length gently sloping (>135°): *100 but above the incised (18") channel; vertical from water to bank with no undercutting.*

% bank length with overhanging vegetation:

BANK CONDITION

% bank length vegetated, stable: *95*

% bank length unvegetated, stable: *1*

% bank length vegetated, unstable: *0*

% bank length unvegetated, unstable: *4*

NOTES:

1) This site had a straightforward area to monitor the riparian zone. The station went from low water to a low terrace, then a high terrace and finally to the aspen forest.
2) This site is within the current planned subsidence zone.

DATA SUMMARY

Q08C: Cover by plant community types in the South Fork Quitchupah Creek drainage (July 2013).

USDA Forest Service Protocol (1992)

	LEFT	RIGHT	TOTALS
UPLAND VEGETATION			
Artemisia tridentata/Grasses	10.00		
Populus tremuloides/Symphoricarpos oreophilus		11.00	
			21.00
RIPARIAN VEGETATION			
Dominant Woody Species			
Rosa woodsii			
Dominant Herbaceous Species			
Carex nebrascensis	3.00	14.00	
Carex nebrascensis/Agrostis stolonifera/Ranunculus cymbalaria	5.00		
			22.00
TOTAL COVER (Upland Species)			21.00
TOTAL COVER (Riparian Species)			22.00
ROCK (channel)			0.00
WATER (channel)			1.00
BAREGROUND (channel)			0.00
LITTER			0.00
MOSS			0.00
TOTAL COVER			44.00

PHOTOGRAPHIC DOCUMENTATION

Q08C

RIPARIAN COMPLEX DATA SHEET
July 2013

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: ***Q09C***

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: Southern Wasatch Plateau, Utah

DATE: *July 24-25, 2013*

OBSERVER(S): *P. Collins*

USGS QUAD 7.5 MINUTE MAP: *Acord Lakes, Utah*

GEOLOGIC PARENT MATERIAL: *Near the contact between the Price River Formation and the Castlegate Sandstone*

STREAM ASPECT: *E*

STREAM GRADIENT: *2-3°*

ELEVATION: *8,253 ft*

SIZE OF COMPLEX: *(see quantitative data)*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: *Sagebrush/Grass* Right: *Sagebrush/Grass*

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

COMMUNITY SUCCESSIONAL STAGE: *Mid*

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *400 lbs/acre*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *1*

PHOTOGRAPH TAKEN: *Yes*

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: *Mining, grazing (cattle & wildlife), hunting, recreation.*

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
	Artemisia tridentata	*Trifolium sp.*	*Agrostis stolonifera*
	Rosa woodsii		*Juncus arcticus*
	Salix boothii		*Poa pratensis*

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°): *100 on both sides of the channel.*

% bank length gently sloping (>135°): *100 but above the incised (24" wide) channel.*

% bank length with overhanging vegetation: *(herbaceous only)*

BANK CONDITION

% bank length vegetated, stable: *90*

% bank length unvegetated, stable: *0*

% bank length vegetated, unstable: *2*

% bank length unvegetated, unstable: *3*

NOTES:

1) This site had a straightforward area to monitor the riparian zone.
2) This site is within the current planned subsidence zone.
3) The riparian species composition seemed to be different from the previous sample period – it was dominated by different species. I noticed the same thing at Q07C (see the notes I wrote there).

DATA SUMMARY

Q09C: Cover by plant community types in the South Fork Quitchupah Creek drainage (July 2013).

USDA Forest Service Protocol (1992)

	LEFT	RIGHT	TOTALS
UPLAND VEGETATION	10.00		
Artemisia tridentata/Grasses		11.00	
Artemisia tridentata/Grasses			21.00
RIPARIAN VEGETATION			
Dominant Woody Species			
Dominant Herbaceous Species			
Poa pratensis/Juncus arcticus	13.00		
Equisetum arvensis/Poa pratensis		1.00	
			14.00
TOTAL COVER (Upland Species)			21.00
TOTAL COVER (Riparian Species)			14.00
ROCK (channel)			0.00
WATER (channel)			1.00
BAREGROUND (channel)			0.00
LITTER			0.00
MOSS			0.00
TOTAL COVER			36.00

PHOTOGRAPHIC DOCUMENTATION

Q09C

SECTION B

RIPARIAN COMPLEX
DATA SHEETS

for the

OCTOBER 2013
SAMPLE PERIOD

RIPARIAN COMPLEX DATA SHEET
October 2013

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: ***Q01C***

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: Southern Wasatch Plateau, Utah

DATE: *October 1-2, 2013*

OBSERVER(S): *P. Collins*

USGS QUAD 7.5 MINUTE MAP: *Acord Lakes, Utah*

GEOLOGIC PARENT MATERIAL: *Price River Formation*

STREAM ASPECT: *East (120°)*

STREAM GRADIENT: *1-2°*

ELEVATION: *8,335 ft*

SIZE OF COMPLEX: *(see quantitative data)*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: *Snowberry/Sagebrush/Grass* Right: *Aspen*

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

COMMUNITY SUCCESSIONAL STAGE: *Mid (tree saplings present)*

APPARENT FORAGE TREND: *Unstable (this had been flooded).*

ESTIMATED FORAGE PRODUCTION: *50 lbs/acre*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=slight; 5=extreme): *5*

PHOTOGRAPH TAKEN: *Yes*

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: *Mining, grazing (cattle & wildlife), hunting and recreation.*

SPECIES OBSERVED:

Trees	**Shrubs**	**Forbs**	**Grasses (or grasslike)**
Populus tremuloides	*Artemisia tridentata*	*Achillea millefolium*	*Carex nebrascensis*
Salix boothii	*Rosa woodsii*	*Taraxacum officinale*	*Juncus arcticus*
	Symphoricarpos oreophilus		*Poa pratensis*

POOL ATTRIBUTES

% area in pools: *50*

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

AQUATIC VEGETATION

% streambed with filamentous algae: *50 (left)*

% stream margin with rooted aquatic: *0*

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90º): *0*

% bank length gently sloping (>135º): *0*

% bank length with overhanging vegetation: *25 (short Booth's willows)*

BANK CONDITION

% bank length vegetated, stable: *10*

% bank length unvegetated, stable: *0*

% bank length vegetated, unstable: *25*

% bank length unvegetated, unstable: *65*

NOTES:

1) This is a stream channel sample site.
2) This is a good creek channel monitoring site. It is outside the cattle trail and readily monitored.
3) Probably a good "control" site (outside the subsidence zone).
4) Cattle were present during this sample period.
5) All stakes were found.
6) There was evidence of a major flood here since the last sample period. The flood impacts were more depositional than erosional (see photograph). The riparian vegetation was greatly impacted.

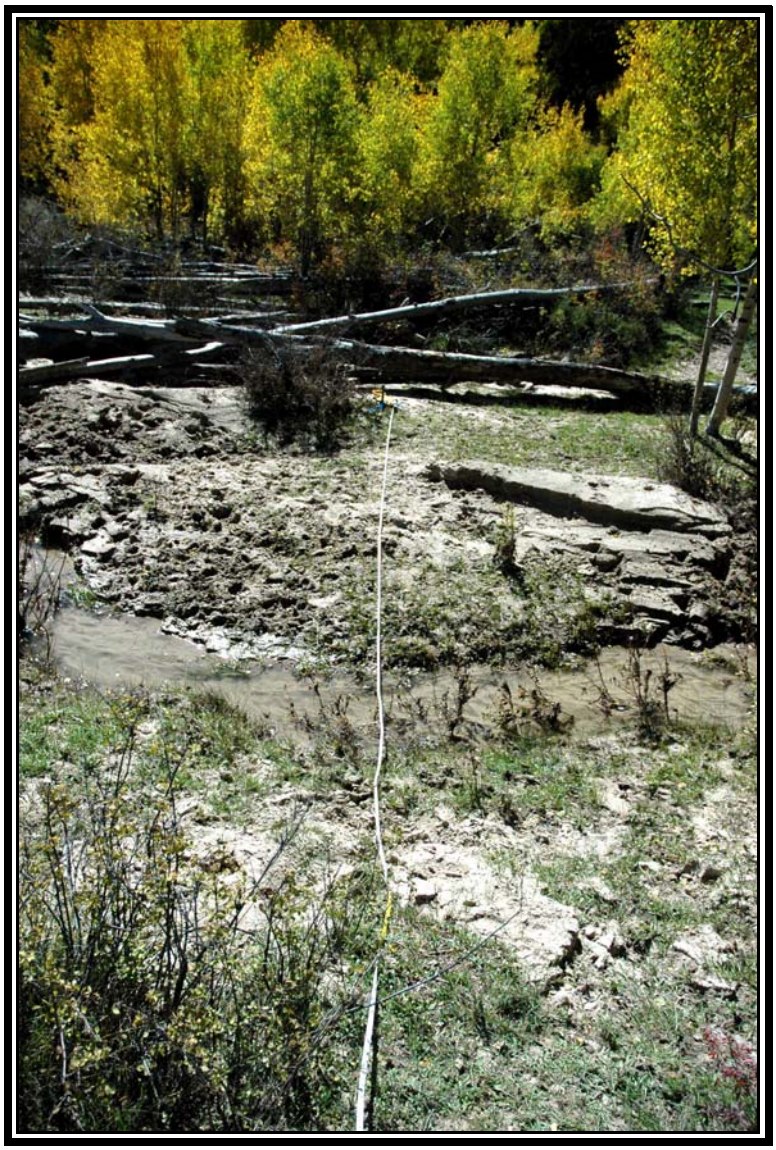
DATA SUMMARY

Q01C: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2013).

USDA Forest Service Protocol (1992)

	LEFT	RIGHT	TOTALS
UPLAND VEGETATION			
Symphoricarpos oreophilus/Artemisia tridentata/Poa pratensis	10.00		
Poa pratensis/Taraxacum officinale		10.00	20.00
RIPARIAN VEGETATION			
Dominant Woody Species			
Rosa woodsii	0.50		
Dominant Herbaceous Species			
Juncus arcticus	1.50		
Carex nebrascensis		4.00	6.00
TOTAL COVER (Upland Species)			20.00
TOTAL COVER (Riparian Species)			6.00
ROCK (channel)			0.00
WATER (channel)			4.00
BAREGROUND (channel)			0.00
LITTER			0.00
MOSS			0.00
TOTAL COVER			30.00

PHOTOGRAPHIC DOCUMENTATION



Q01C

RIPARIAN COMPLEX DATA SHEET
October 2013

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: ***Q02S***

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: Southern Wasatch Plateau, Utah

DATE: *October 1-2, 2013*

OBSERVER(S): *P. Collins*

USGS QUAD 7.5 MINUTE MAP: *Acord Lakes, Utah*

GEOLOGIC PARENT MATERIAL: *Price River Formation*

STREAM ASPECT: *E; Flow is NE (50°)*

STREAM GRADIENT: *1-2°*

ELEVATION: *8,330 ft*

SIZE OF COMPLEX: *(see quantitative data)*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: *Aspen* Right: *Aspen*

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

COMMUNITY SUCCESSIONAL STAGE: *Mid*

APPARENT FORAGE TREND: *Decreasing (ground cover was mud and vegetation)*

ESTIMATED FORAGE PRODUCTION: *200 lbs/acre*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *Inside of spring =4 (in cattle tracks); outside=4*

PHOTOGRAPH TAKEN: *Yes*

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: *Mining, grazing (cattle & wildlife), hunting, recreation.*

SPECIES OBSERVED:

Trees	**Shrubs**	**Forbs**	**Grasses (or grasslike)**
Picea pungens	*Ribes sp.*	*Achillea millefolium*	*Agrostis stolonifera*
Populus tremuloides	*Symphoricarpos oreophilus*	*Equisetum arvense*	*Carex nebrascensis*
		Ranunculus cymbalaria	*Poa pratensis*
		Taraxacum officinale	

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 (<90º): *0*

% bank length gently sloping (>135º): *100*

% bank length with overhanging vegetation: *0*

BANK CONDITION	Center	Side
% bank length vegetated, stable:	*0*	*60*
% bank length unvegetated, stable:	*50*	*20*
% bank length vegetated, unstable:	*0*	*5*
% bank length unvegetated, unstable:	*50*	*15*

NOTES:

1) This is a spring area.
2) Probably a good "control" site (outside the subsidence zone).
3) There were lots of cattle hoof-prints (disturbance).
4) All stakes were located.
4) The Bank Condition represents both the bank and wet areas (refer to the photograph).
5) Lots of cattle impact here.
6) The spring was mostly wet (muddy). There was only about 1 ft of water in the center.

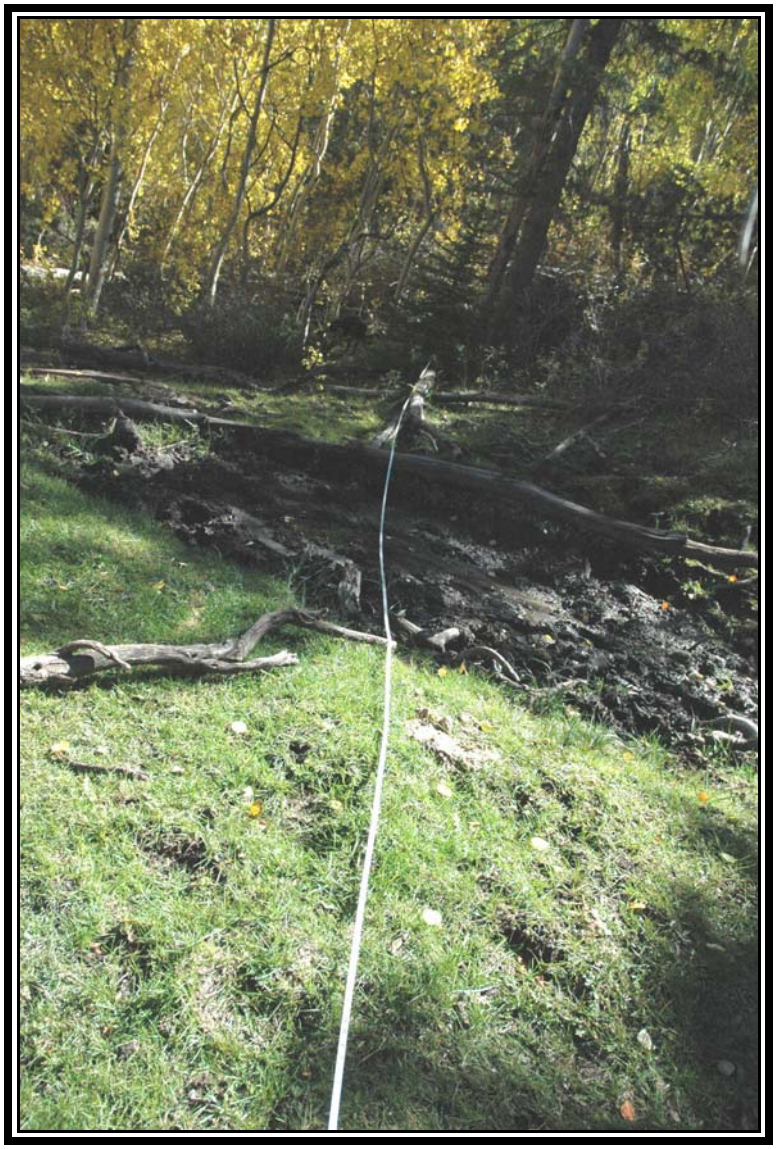
DATA SUMMARY

Q02S: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2013).

USDA Forest Service Protocol (1992)

	LEFT	RIGHT	TOTALS
UPLAND VEGETATION			
Poa pratensis/Achillea millefolium	10.00		
Geranium richardsonii/Poa pratensis		8.00	
			18.00
RIPARIAN VEGETATION			
Dominant Woody Species			
Dominant Herbaceous Species			
Ranunculus cymbalaria/Agrostis stolonifera		6.00	
Carex nebrascensis	1.00		7.00
TOTAL COVER (Upland Species)			18.00
TOTAL COVER (Riparian Species)			7.00
ROCK (channel)			0.00
WATER (channel)			1.00
BAREGROUND (channel)			7.00
LITTER			0.00
MOSS			0.00
TOTAL COVER			33.00

PHOTOGRAPHIC DOCUMENTATION



Q02S

RIPARIAN COMPLEX DATA SHEET
October 2013

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: ***Q03C***

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: Southern Wasatch Plateau, Utah

DATE: *October 1-2, 2013*

OBSERVER(S): *P. Collins*

USGS QUAD 7.5 MINUTE MAP: *Acord Lakes, Utah*

GEOLOGIC PARENT MATERIAL: *Price River Formation*

STREAM ASPECT: *E (90°)*

STREAM GRADIENT: *1-2°*

ELEVATION: *8,310 ft*

SIZE OF COMPLEX: *(see quantitative data)*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: *Sagebrush/Grass* Right: *Aspen*

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

COMMUNITY SUCCESSIONAL STAGE: *Mid (tree saplings present)*

APPARENT FORAGE TREND: *Unstable from recent flooding impact.*

ESTIMATED FORAGE PRODUCTION: *200 lbs/acre (decreased due to flooding)*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *3 (on river bank near the water).*

PHOTOGRAPH TAKEN: *Yes*

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: *Mining, grazing (cattle & wildlife), hunting, recreation.*

SPECIES OBSERVED:

Trees	**Shrubs**	**Forbs**	**Grasses (or grasslike)**
Populus tremuloides	*Artemisia tridentata*	*Aster sp.*	*Agrostis stolonifera*
	Rosa woodsii	*Equisetum arvense*	*Juncus arcticus*
	Salix spp.	*Taraxacum officinale*	

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 on both sides due to flooding.*

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

% bank length with overhanging vegetation: *0*

BANK CONDITION

% bank length vegetated, stable: *25*

% bank length unvegetated, stable: *0*

% bank length vegetated, unstable: *10*

% bank length unvegetated, unstable: *65*

NOTES:

1) This is a channel site.
2) A good control station; outside current subsidence plans.
3) It seems like we needed a sample here, but this may be more difficult to monitor as accurately due to the topography. The narrow channel sites are more straight-forward to monitor than this type.
4) Interestingly, the adjacent aspen understory (that I considered upland) had more wiregrass present. This may be a function of the shade prolonging snow-melt. This area was covered by deposition due to floods (see below).
5) This wiregrass area should be noted during each sample period.
6) On the right side, it is difficult to separate the upland from the riparian.
7) There was evidence of a major flood here since the last sample period. The flood impacts were depositional (floodplains) and erosional (stream channel). The riparian vegetation was greatly impacted.

DATA SUMMARY

Q03C: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2013).

USDA Forest Service Protocol (1992)

	LEFT	RIGHT	TOTALS
UPLAND VEGETATION			
Artemisia tridentata/Elymus salinus	10.00		
Populus tremuloides/Juncus arcticus		13.00	
			23.00
RIPARIAN VEGETATION			
Dominant Woody Species			
Dominant Herbaceous Species			
Juncus arcticus	8.00	2.00	
			10.00
TOTAL COVER (Upland Species)			23.00
TOTAL COVER (Riparian Species)			10.00
ROCK (channel)			0.00
WATER (channel)			2.00
BAREGROUND (channel)			0.00
LITTER			0.00
MOSS			0.00
TOTAL COVER			35.00

PHOTOGRAPHIC DOCUMENTATION

Q03C

RIPARIAN COMPLEX DATA SHEET
October 2013

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: ***Q04S***

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: Southern Wasatch Plateau, Utah

DATE: *October 1-2, 2013*

OBSERVER(S): *P. Collins*

USGS QUAD 7.5 MINUTE MAP: *Acord Lakes, Utah*

GEOLOGIC PARENT MATERIAL: *Price River Formation*

STREAM ASPECT: *E [but flow here was N (340°)*]

STREAM GRADIENT: *1-2°*

ELEVATION: *8,310 ft*

SIZE OF COMPLEX: *(see quantitative data)*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: *Aspen* Right: *Aspen/Blue Spruce/Willow*

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

COMMUNITY SUCCESSIONAL STAGE: *Late*

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *700 lbs/acre*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *3 (cattle impacts)*

PHOTOGRAPH TAKEN: *Yes*

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: *Mining, grazing (cattle & wildlife), hunting, recreation.*

SPECIES OBSERVED:

Trees	**Shrubs**	**Forbs**	**Grasses (or grasslike)**
Picea pungens	*Rosa woodsii*	*Achillea millefolium*	*Eleocharis palustris*
Populus tremuloides	*Salix boothii*	*Equisetum arvense*	*Hordeum jubatum*
		Geranium richardsonii	*Juncus arcticus*
			Juncus longistylis
			Poa pratensis

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°): *100*

% bank length with overhanging vegetation: *50*

BANK CONDITION

% bank length vegetated, stable: *35*

% bank length unvegetated, stable: *0*

% bank length vegetated, unstable: *15*

% bank length unvegetated, unstable: *50*

NOTES:

1) This is a spring area.

2) It is a good control station; outside current subsidence plans.

3) The spring site had several zones of vegetation based on the different water regimes.

4) Nebraska sedge and spike rush zones seemed to be the wettest areas.

5) There was a lot of impact from cattle trampling here. Because of this some areas had a higher living cover value, whereas other areas were relatively low.

6) There was much more water when compared to July when there was almost no water present - about 50% of the hoof prints had some water in them, the remainder were muddy.

DATA SUMMARY

Q04S: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2013).

USDA Forest Service Protocol (1992)

	LEFT	RIGHT	TOTALS
UPLAND VEGETATION			
Symphoricarpos oreophilus/Populus tremuloides	9.00		
		10.00	
			19.00
RIPARIAN VEGETATION			
Dominant Woody Species			
Dominant Herbaceous Species			
Ranunculus cymbalaria/Carex nebrascensis		6.00	6.00
Carex nebrascensis	8.00	6.00	14.00
TOTAL COVER (Upland Species)			19.00
TOTAL COVER (Riparian Species)			20.00
ROCK (channel)			0.00
WATER (channel)			9.00
BAREGROUND (channel)			8.00
LITTER			0.00
MOSS			0.00
TOTAL COVER			56.00

PHOTOGRAPHIC DOCUMENTATION

Q04S

RIPARIAN COMPLEX DATA SHEET
October 2013

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: ***Q05S***

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: Southern Wasatch Plateau, Utah

DATE: *October 1-2, 2013*

OBSERVER(S): *P. Collins*

USGS QUAD 7.5 MINUTE MAP: *Acord Lakes, Utah*

GEOLOGIC PARENT MATERIAL: *Price River Formation*

STREAM ASPECT: *E; flow here was 30°*

STREAM GRADIENT: *1-2°*

ELEVATION: *8,294 ft*

SIZE OF COMPLEX: *(see quantitative data)*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: *Blue Spruce/Willow* Right: *Blue Spruce/Aspen*

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

COMMUNITY SUCCESSIONAL STAGE: *Late*

APPARENT FORAGE TREND: *Stable, but cattle were making it less stable.*

ESTIMATED FORAGE PRODUCTION: *700 lbs/acre*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *4 (due to cattle)*

PHOTOGRAPH TAKEN: *Yes*

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: *Mining, grazing (cattle & wildlife), hunting, recreation.*

SPECIES OBSERVED:

Trees	**Shrubs**	**Forbs**	**Grasses (or grasslike)**
Picea pungens	*Salix boothii*	*Equisetum arvense*	*Agrostis stolonifera*
Pinus flexilis	*Symphoricarpos oreophilus*	*Geranium richardsonii*	*Carex nebrascensis*
Populus tremuloides		*Ranunculus cymbalaria*	

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°): *100*

% bank length with overhanging vegetation: *20*

BANK CONDITION

% bank length vegetated, stable: *55*

% bank length unvegetated, stable: *5*

% bank length vegetated, unstable: *20 (due to cattle)*

% bank length unvegetated, unstable: *20*

NOTES:

1) This is a well-defined spring area.
2) A good control station; it is just outside current subsidence plans.
3) When I placed the transect tape, it formed a "U" shape to measure. This tape was placed 4 ft from the upland bank for 73 ft of riparian/spring vegetation.
4) For this sample period, the water area comprised about 40% of the 73 ft mentioned above.
5) There was a lot of impact from cattle trampling at the site.
6) There was vegetation and mud present in the spring at the transect line (no water was present in July, but quite a bit in October).

DATA SUMMARY

Q05S: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2013).

USDA Forest Service Protocol (1992)

	LEFT	RIGHT	TOTALS
UPLAND VEGETATION			
Salix boothii/Picea pungens	10.00		
Picea pungens/Populus tremuloides		10.00	
			20.00
RIPARIAN VEGETATION			
Dominant Woody Species			
Dominant Herbaceous Species			
Carex nebrascensis/Agrostis stolonifera/Ranunculus cymbalaria	36.50	36.50	
			73.00
TOTAL COVER (Upland Species)			20.00
TOTAL COVER (Riparian Species)			73.00
ROCK (channel)			0.00
WATER (channel)			0.00
BAREGROUND (channel)			0.00
LITTER			0.00
MOSS			0.00
TOTAL COVER			93.00

PHOTOGRAPHIC DOCUMENTATION

Q05S

RIPARIAN COMPLEX DATA SHEET
October 2013

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: ***Q06S***

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: Southern Wasatch Plateau, Utah

DATE: *October 1-2, 2013*

OBSERVER(S): *P. Collins*

USGS QUAD 7.5 MINUTE MAP: *Acord Lakes, Utah*

GEOLOGIC PARENT MATERIAL: *Price River Formation*

STREAM ASPECT: *E [but flow here was N (330°)*]

STREAM GRADIENT: *1-2°*

ELEVATION: *8,313 ft*

SIZE OF COMPLEX: *(see quantitative data)*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: *Meadow* Right: *Meadow*

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

COMMUNITY SUCCESSIONAL STAGE: *Late*

APPARENT FORAGE TREND: *Semi-stable due to cattle impacts*

ESTIMATED FORAGE PRODUCTION: *400 lbs/acre*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *4 (cattle impact)*

PHOTOGRAPH TAKEN: *Yes*

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: *Mining, grazing (cattle & wildlife), hunting, recreation.*

SPECIES OBSERVED:

Trees	**Shrubs**	**Forbs**	**Grasses (or grasslike)**
Populus tremuloides	*Ribes sp*	*Equisetum arvense*	*Agrostis stolonifera*
	Salix boothii	*Taraxacum officinale*	*Poa pratensis*

POOL ATTRIBUTES

% area in pools: *0 (not water but it was muddy).*

% 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: *25*

BANK CONDITION

% bank length vegetated, stable: *85*

% bank length unvegetated, stable: *5*

% bank length vegetated, unstable: *0*

% bank length unvegetated, unstable: *15 (cattle impact)*

NOTES:

1) Only measured obvious, well-defined spring area.
2) Left side measured to bank (3 ft).
3) Cattle had a great impact for this sample period. Therefore, the riparian vegetation was almost all located on the side of the spring channel.
4) Riparian/wetland vegetation was measured in the spring channel only.
5) The bank was stable, the spring was not.
6) The sample station was located within current planned subsidence zone.

DATA SUMMARY

Q06S: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2013).

USDA Forest Service Protocol (1992)

	LEFT	RIGHT	TOTALS
UPLAND VEGETATION			
Populus tremuloides/Salix boothii	3.00		
Symphoricarpos oreophilus/Grasses		9.00	
			12.00
RIPARIAN VEGETATION			
Dominant Woody Species			
Dominant Herbaceous Species			
Agrostis stolonifera	7.00	1.00	8.00
TOTAL COVER (Upland Species)			12.00
TOTAL COVER (Riparian Species)			8.00
ROCK (channel)			0.00
WATER (channel)			0.00
BAREGROUND (channel)			0.00
LITTER			0.00
MOSS			0.00
TOTAL COVER			20.00

PHOTOGRAPHIC DOCUMENTATION

Q06S

RIPARIAN COMPLEX DATA SHEET
October 2013

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: ***Q07C***

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: Southern Wasatch Plateau, Utah

DATE: *October 4, 2012*

OBSERVER(S): *P. Collins*

USGS QUAD 7.5 MINUTE MAP: *Acord Lakes, Utah*

GEOLOGIC PARENT MATERIAL: *Price River Formation*

STREAM ASPECT: *E [but flow here was N (5°)]*

STREAM GRADIENT: *2-3°*

ELEVATION: *8,285 ft*

SIZE OF COMPLEX: *(see quantitative data)*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: *Meadow* Right: *Meadow*

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

COMMUNITY SUCCESSIONAL STAGE: *Mid*

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *1,100 lbs/acre*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *1*

PHOTOGRAPH TAKEN: *Yes*

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: *Mining, grazing (cattle & wildlife), hunting, recreation.*

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
	Rosa woodsii	*Achillea millefolium*	*Agrostis stolonifera*
	Salix boothii	*Trifolium sp.*	*Carex nebrascensis*
			Hordeum jubatum
			Poa pratensis

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°): *100 now due to flooding.*

% bank length gently sloping (>135°): *100 incised (18") channel*

% bank length with overhanging vegetation: *85 (herb.)*

BANK CONDITION

% bank length vegetated, stable: *70*

% bank length unvegetated, stable: *10*

% bank length vegetated, unstable: *10*

% bank length unvegetated, unstable: *10*

NOTES:

1) This site is in the middle of a meadow.

2) Right side: This area looked different than the last sample period. This side had little upland vegetation (some foxtail barley). Like in July the transect line was mostly all riparian vegetation with a lot Nebraska sedge. I think these communities are dynamic and can show year-to-year differences based on water regimes. For example, I think in the dryer years different species are more prominent for cover and production and the same for the wetter years.

3) Left side: The riparian community was measured beginning in the meadow (where the stake would be easily found later) and ended at the channel bank. The entire meadow, however, had some wetland species, but less cover due to flooding (see below).

4) There was evidence of a major flood here since the last sample period. The flood impacts were more depositional than erosional.

5) This site is within the current planned subsidence zone.
6) There was cattle at the site when I was sampling

DATA SUMMARY

Q07C: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2013).

USDA Forest Service Protocol (1992)

	LEFT	RIGHT	TOTALS
UPLAND VEGETATION	0.00		
Poa pratensis/Achillea millefolium		0.00	
Poa pratensis/Achillea millefolium			0.00
RIPARIAN VEGETATION			
Dominant Woody Species			
Rosa woodsii	5.00		
Dominant Herbaceous Species			
Carex nebrascensis	13.50		
Carex nebrascensis/Hordeum jubatum			
Juncus arcticus	28.50	7.00	54.00
TOTAL COVER (Upland Species)			0.00
TOTAL COVER (Riparian Species)			54.00
ROCK (channel)			0.00
WATER (channel)			1.00
BAREGROUND (channel)			0.00
LITTER			0.00
MOSS			0.00
TOTAL COVER			55.00

PHOTOGRAPHIC DOCUMENTATION

Q07C

RIPARIAN COMPLEX DATA SHEET
October 2013

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: ***Q08C***

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: Southern Wasatch Plateau, Utah

DATE: *October 4, 2012*

OBSERVER(S): *P. Collins*

USGS QUAD 7.5 MINUTE MAP: *Acord Lakes, Utah*

GEOLOGIC PARENT MATERIAL: *Price River Formation*

STREAM ASPECT: *E (flow here was 140°)*

STREAM GRADIENT: *2-3°*

ELEVATION: *8,253 ft*

SIZE OF COMPLEX: *(see quantitative data)*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: *Sagebrush/Grass* Right: *Aspen/Snowberry*

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

COMMUNITY SUCCESSIONAL STAGE: *Early due to flooding.*

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *700 lbs/acre*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *1 (banks)*

PHOTOGRAPH TAKEN: *Yes*

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: *Mining, grazing (cattle & wildlife), hunting, recreation.*

SPECIES OBSERVED:

Trees	**Shrubs**	**Forbs**	**Grasses (or grasslike)**
Populus tremuloides	*Artemisia tridentata*	*Trifolium sp.*	*Agrostis stolonifera*
	Salix boothii		*Carex nebrascensis*
			Juncus arcticus

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: *25*

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*

% bank length gently sloping (>135°): *100 but above the incised (12") channel; vertical from water to bank with no undercutting.*

% bank length with overhanging vegetation:

BANK CONDITION

% bank length vegetated, stable: *55 (less due flooding)*

% bank length unvegetated, stable: *20*

% bank length vegetated, unstable: *5*

% bank length unvegetated, unstable: *20*

NOTES:

1) This site had a straightforward area to monitor the riparian zone. The station went from low water to a low terrace, then a high terrace and finally to the aspen forest.
2) This site is within the current planned subsidence zone.
3) There was evidence of a major flood here since the last sample period. The flood impacts were more depositional than erosional. The riparian vegetation was greatly impacted and the living cover decreased, possibly covered over, as a result.

DATA SUMMARY

Q08C: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2013).

USDA Forest Service Protocol (1992)

	LEFT	RIGHT	TOTALS
UPLAND VEGETATION			
Artemisia tridentata/Grasses	10.00		
Populus tremuloides/Symphoricarpos oreophilus		15.00	
			25.00
RIPARIAN VEGETATION			
Dominant Woody Species			
Rosa woodsii			
Dominant Herbaceous Species			
Carex nebrascensis		9.50	
Carex nebrascensis/Juncus arcticus	6.50		
			16.00
TOTAL COVER (Upland Species)			25.00
TOTAL COVER (Riparian Species)			16.00
ROCK (channel)			0.00
WATER (channel)			3.00
BAREGROUND (channel)			0.00
LITTER			0.00
MOSS			0.00
TOTAL COVER			44.00

PHOTOGRAPHIC DOCUMENTATION

Q08C

Note depositional layer

RIPARIAN COMPLEX DATA SHEET
October 2013

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: ***Q09C***

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: Southern Wasatch Plateau, Utah

DATE: *October 1-2, 2013*

OBSERVER(S): *P. Collins*

USGS QUAD 7.5 MINUTE MAP: *Acord Lakes, Utah*

GEOLOGIC PARENT MATERIAL: *Near the contact between the Price River Formation and the Castlegate Sandstone*

STREAM ASPECT: *E*

STREAM GRADIENT: *2-3°*

ELEVATION: *8,253 ft*

SIZE OF COMPLEX: *(see quantitative data)*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: *Sagebrush/Grass* Right: *Sagebrush/Grass*

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

COMMUNITY SUCCESSIONAL STAGE: *Early due to floods*

APPARENT FORAGE TREND: *Unstable*

ESTIMATED FORAGE PRODUCTION: *100 lbs/acre (less due to floods).*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *1*

PHOTOGRAPH TAKEN: *Yes*

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: *Mining, grazing (cattle & wildlife), hunting, recreation.*

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
	Artemisia tridentata	*Trifolium sp.*	*Agrostis stolonifera*
	Rosa woodsii		*Juncus arcticus*
	Salix boothii		*Poa pratensis*

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°): *Previously 100 on both sides of the channel, but the flooding filled them in.*

% bank length gently sloping (>135°): *100 but above the incised (18" wide) channel.*

% bank length with overhanging vegetation: *(herbaceous only)*

BANK CONDITION

% bank length vegetated, stable: *20*

% bank length unvegetated, stable: *40*

% bank length vegetated, unstable: *20*

% bank length unvegetated, unstable: *20*

NOTES:

1) This site had a straightforward area to monitor the riparian zone.

2) This site is within the current planned subsidence zone.

3) Keep in mind that the transect vegetation width may be consistent, but the total living cover may have decreased within the transect zone due to flooding & deposition. This area was a good example of that .

4) The deposition may also render the area somewhat dryer.

DATA SUMMARY

Q09C: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2013).

USDA Forest Service Protocol (1992)

	LEFT	RIGHT	TOTALS
UPLAND VEGETATION	10.00		
Artemisia tridentata/Grasses		10.00	
Artemisia tridentata/Grasses			20.00
RIPARIAN VEGETATION			
Dominant Woody Species			
Dominant Herbaceous Species			
Equisetum arvense/Poa pratensis		2.00	
Juncus arcticus	12.50		
			14.50
TOTAL COVER (Upland Species)			20.00
TOTAL COVER (Riparian Species)			14.50
ROCK (channel)			0.00
WATER (channel)			1.50
BAREGROUND (channel)			0.00
LITTER			0.00
MOSS			0.00
TOTAL COVER			36.00

PHOTOGRAPHIC DOCUMENTATION

Q09C

Depositional layer

RIPARIAN COMPLEX DATA SHEET
October 2013

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: ***Q10S***

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 9, 2013*

OBSERVER(S): *P. Collins, E. Petersen, R. Long*

USGS QUAD 7.5 MINUTE MAP: *Acord Lakes, Utah*

GEOLOGIC PARENT MATERIAL: *Contact of Blackhawk Fm & Castlegate Sandstone*

STREAM ASPECT: *E*

STREAM GRADIENT: *2-3°*

ELEVATION: *8,046 ft*

SIZE OF COMPLEX: *(see quantitative data)*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: *Conifer* Right: *Conifer*

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

COMMUNITY SUCCESSIONAL STAGE: *Unstable*

APPARENT FORAGE TREND: *Unstable*

ESTIMATED FORAGE PRODUCTION: *100 lbs/acre*

BEAVER ACTIVITY: *No*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *5*

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing (cattle & wildlife), hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Cornus sericea		*Equisetum arvense*	
Populus tremuloides		*Viola adunca*	
Pseudotsuga menziesii			
Rosa woodsii			

POOL ATTRIBUTES

% area in pools: *25*

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

AQUATIC VEGETATION

% streambed with filamentous algae: *0*

% stream margin with rooted aquatic: *0*

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°):*0*

% bank length gently sloping (>135°): *75 (average)*

% bank length with overhanging vegetation: *50 (conifers)*

BANK CONDITION	Left	Right
% bank length vegetated, stable:	*10*	*20*
% bank length unvegetated, stable:	*80*	*80*
% bank length vegetated, unstable:	*0*	*0*
% bank length unvegetated, unstable:	*10*	*0*

NOTES:

1) This site, also called Wedge Spring, is often measured for flow by a hydrologist.
2) It had rather low vegetative cover.
3) Water surfaced at a couple of locations.
4) The bottom-line is that there was not much riparian vegetation and it may be difficult to monitor. There was a great deal of horsetail on the left side with some hillside moisture influence coming in contact with the spring zone.
5) The spring was rather muddy and unstable from a vegetation standpoint.
6) Because of recent mining expansion plans, this was the first sample period for this station.

DATA SUMMARY

Q10S: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2013).

USDA Forest Service Protocol (1992)

	LEFT	RIGHT	TOTALS
UPLAND VEGETATION	0.00		
Conifer		10.00	
Conifer			10.00
RIPARIAN VEGETATION			
Dominant Woody Species			
Cornus sericea/Equisetum arvense		7.00	
Dominant Herbaceous Species			
Equisetum arvense	22.00	22.00	
			51.00
TOTAL COVER (Upland Species)			10.00
TOTAL COVER (Riparian Species)			51.00
ROCK (channel)			4.00
WATER (channel)			4.50
BAREGROUND/MUD (channel)			6.50
LITTER			1.00
MOSS			0.00
TOTAL COVER			77.00

PHOTOGRAPHIC DOCUMENTATION

Q10S

Q10S (closeup)

RIPARIAN COMPLEX DATA SHEET
October 2013

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: ***Q11C***

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 9, 2013*

OBSERVER(S): *P. Collins, E. Petersen, R. Long*

USGS QUAD 7.5 MINUTE MAP: *Acord Lakes, Utah*

GEOLOGIC PARENT MATERIAL: *Blackhawk Fm*

STREAM ASPECT: *E*

STREAM GRADIENT: *2-3°*

ELEVATION: *7,780 ft*

SIZE OF COMPLEX: *(see quantitative data)*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: *Aspen/Conifer* Right: *Douglas Fir*

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

COMMUNITY SUCCESSIONAL STAGE: *Early due to floods*

APPARENT FORAGE TREND: *Decreasing*

ESTIMATED FORAGE PRODUCTION: *400 lbs/acre*

BEAVER ACTIVITY: *Yes (upstream)*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *5 (see photo)*

PHOTOGRAPH TAKEN: *Yes*

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA*: Mining, grazing (cattle & wildlife), hunting, recreation flooding.*

SPECIES OBSERVED:

Trees	**Shrubs**	**Forbs**	**Grasses (or grasslike)**
Abies concolor	*Chrysothamnus nauseosus*	*Trifolium sp.*	*Agrostis stolonifera*
Cornus sericea			*Juncus arcticus*
Populus tremuloides			*Poa pratensis*
Pseudotsuga menziesii			
Salix lutea?			

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: *50*

BANK CONDITION

% bank length vegetated, stable: *30*

% bank length unvegetated, stable: *20*

% bank length vegetated, unstable: *30*

% bank length unvegetated, unstable: *20*

NOTES:

1) Because of recent mining expansion plans, this was the first sample period for this station.
2) Recent flooding appears to have greatly impacted the riparian community here.
3) This site was placed at water sampling station (called 006D).

DATA SUMMARY

Q11C: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2013).

USDA Forest Service Protocol (1992)

	LEFT	RIGHT	TOTALS
UPLAND VEGETATION			
Populus tremuloides/Abies concolor	6.00		
Pseudotsuga menziesii		2.00	
			8.00
RIPARIAN VEGETATION			
Dominant Woody Species			
Cornus sericea	5.00	6.00	
			11.00
Dominant Herbaceous Species			
TOTAL COVER (Upland Species)			8.00
TOTAL COVER (Riparian Species)			11.00
ROCK (channel)			6.00
WATER (channel)			5.00
BAREGROUND (channel)			0.00
LITTER			0.00
MOSS			0.00
TOTAL COVER			30.00

PHOTOGRAPHIC DOCUMENTATION

Q11C

NOTE: *We also visited another water station upstream from Q11C (or water station 006C). This site also had the potential for establishment of another riparian monitoring station. However, the recent flooding that has been described at several other stations appeared to have nearly devastated the vegetation here. Almost all that remained were small Red-osier dogwood (Cornus sericea) trees (more shrub-sized) lying prostrate in the channel. Some of these trees will likely survive.*

I saw no reason to monitoring this site's vegetation from year to year because it can only improve – or it is my opinion that subsidence from mining could not negatively impact this community in the future any more than the recent flooding has done (see the photographs).

To substantiate the above comments, the water monitoring station (006C) could be easily viewed from the rim of the canyon using a spotting scope or binoculars. Qualitative data could be recorded at that time if desired.

Hydrogeologist, Erik Petersen, sampling the water at station 006C

Water sampling station 006C

Various Columbines in Box Canyon

09/24/2013

09/24/2013

09/24/2013

09/24/2013

09/24/2013

09/24/2013

09/24/2013

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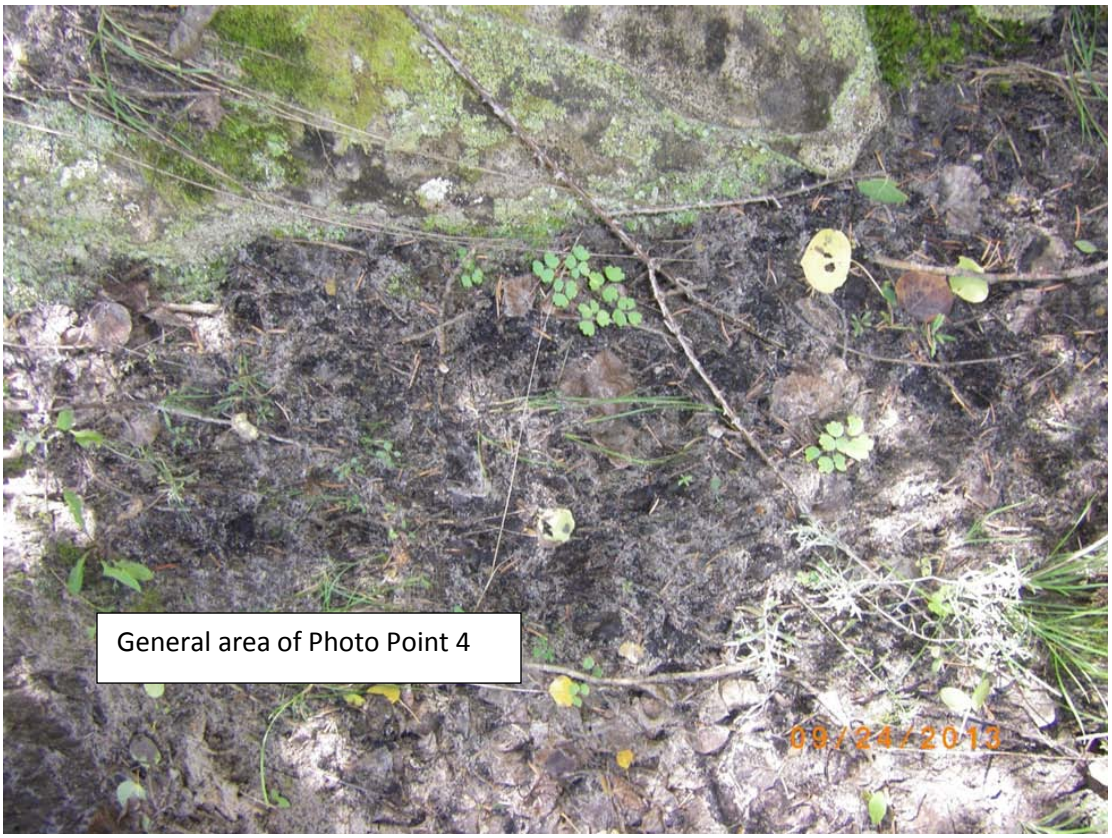
09/24/2013

Photo Point 7

Photo Point 9B



General area of Photo Point 4

Photo Point 9A

Photo Point 5

Photo Point 8

Photo Point 9B

General Area of Photo 10

General Area of Photo 10, Note signs of flooding due to storms in September.

General Area of Photo Point 6

Photo Point 3

Columbine Growing in Box Canyon Walls

Photo Point 1A and 2

Photo Point 1B

LINK TRAIL COLUMBINE (Aguilegia flavenscens var rubicunda) SURVEY 1999 thru 2013

USDA-FS Region 4 Sensitive Species

Found by Forest Service in 1999 at Upper end of the Main Fork of Box Canyon in Grotto Area

Photo Locations No. & Description	Condition/Vigor				
	1999	2000	2001	2002	2003
1A - Grotto Area Plant in Crack	F	P	F to G	P to F	P to F
1B - Grotto Area Plant in Crack	F	P	F to G	P to F	P to F
1C - Grotto Area Plant in Crack	F	P	F to G	P to F	P to F
2 - Gotto Area Multiple Plants in Cracks - 3 Plants	F	P	F to G	P to F	P to F
3A - Grotto Area Base of Rocks	F	P	F to G	P to F	P to F
3B - Grotto Area Base of Rocks	F	P	F to G	P to F	P to F
4 - Halfway Down Box Canyon, Limited Water	G	NA	G	G	P to F
5W - Riparian Areas in Bottom of Box Canyon	G	P	G	P	F
5T - Columbine Photo	G	P	G	NA	NA
6W & 6T - Riparian Area - No Columbine	NA	NA	G	P	F
7 - Columbine(s) - No Plants after 2001	G	P	F	P	P
8 - Hanging Ferns	NA	P	P	P	P
9A- Hanging Ferns and Moss	NA	P	P	P to F	P
9B - Hanging Ferns and Moss	NA	P	P	P to F	P
10W - Riparian Vegetation	NA	NA	G	P	G
10T - Riparian Vegetation	NA	NA	G	P	P
Grazing Impacts	No	Yes	No	Yes	No

	2004	2005	2006	2007	2008
1A - Grotto Area Plant in Crack	F	G	G	G	F
1B - Grotto Area Plant in Crack - 2 Plants	F to G	G	G	G	G
1C - Grotto Area Plant in Crack	F	G	G	G	Dead?
2 - Gotto Area Plants in Cracks - 2 to 3 Plants	F	G	G	F	F
3A & 3B - Grotto Area Base of Rocks - 2 Plants	F	F	F to G	F	F
4 - Halfway Down Box Canyon, Limited Water	F to G	G	G	P	F
5W - Riparian Areas in Bottom of Box Canyon	F to G	G+	P to F	F	P
6W & 6T - Riparian Area - No Columbine	P	G	P to F	P to F	P
7 - No Columbine Plants after 2001	P	P	P	P	P
8 - Hanging Ferns	F	G	G	F	F to G
9A- Hanging Ferns and Moss	F	G	G	G	G
9B - Hanging Ferns and Moss	F	G	G	G	G
10W - Riparian Vegetation	P	G	F	P	P
10T - Riparian Vegetation	P	G	F to G	G	G
Grazing Impacts	Yes	No	Yes	No	Yes

	2009	2010	2011	2012	2013
1A - Grotto Area Plant in Crack	F	F	G	F	F
1B - Grotto Area Plant in Crack	F to G	G	F to G	F	F
1C - Grotto Area Plant in Crack	Dead ?	Dead	Dead	Dead	NA

2 - Gotto Area 1 to 2 Plants	F	P	F to G	F	F
3A & 3B - Grotto Area Base of Rocks - 2 Plants	F	F	G	G	G
4 - Halfway Down Box Canyon, Limited Water	P	P	F to G	F	F
5W - Riparian Areas in Bottom of Box Canyon	P	P to F	G	P	F to G
6W & 6T - Riparian Area - No Columbine	<P	<P	G	P to F	G
7 - No Columbine Plants after 2001	<P	<P	G	F	G
8 - Hanging Ferns	F	P	F	F	F
9A- Hanging Ferns and Moss	F	P	G	F	F
9B - Hanging Ferns and Moss	F	F	G	F	F
10W - Riparian Vegetation	<P	<P	P to F	<P	F
10T - Riparian Vegetation	G	G	G+	G+	G
Grazing Impacts	Yes	Light	No	Yes	No

Legend - Condition/Vigor

P - Poor F - Fair G- Good

< Less Than + Better Than

DOGM required the following:

Stake Location of some plants

Make photographic record of the species

Revisit plot locations annually until the area has been subsided

Determine if mining has any affect on the plants

Include riparian and hanging fern garden areas, starting in 2000

Conclusions

The location of the plants did not seem to be associated with moisutre draining to the surface.

The columbine grows in or adjacent to the Castlegate formation and not in close association to other plants.

Survey suggests they do not compete well in the established phase of growth cycle with other plants.

Some columbines will grow in well drained sandy soils within a flood plain, likely establishing following a flood carrying seed.

Columbine does not necessarily need moist soil climate to survive.

Columbine survival is dependent on growing in protected areas, not easily accessible to grazing.

During survey no impacts attributed to mining.

Impacts likely due to drought conditions and grazing.

The Box Canyon area was under-mined in Late December 2005 and Early January 2006.

Survey/Study reports included in annual reports 1999 thru 2012

LINK CANYON MINE PORTAL
VEGETATION STUDY

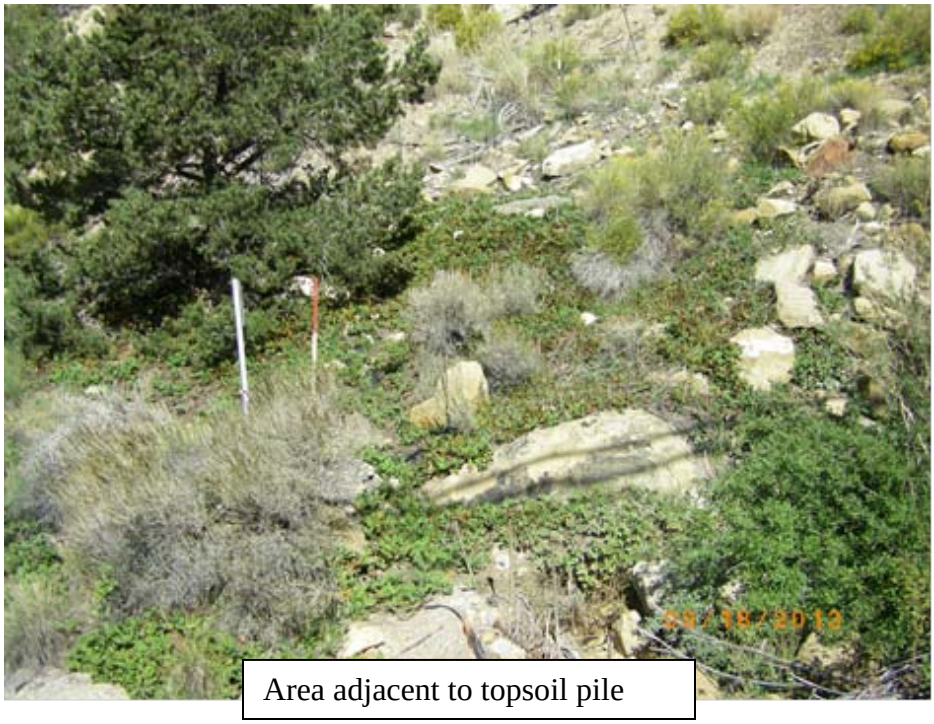
September 18, 2013

Photographs were retaken at the Link Canyon Mine Portal area one week after rains finished in September. Due to low moisture the remainder of the year, growth on the perennial plants has been below normal. Due to the heavy rains the first part of September there was evidence of overland flow in the adjacent stream bed this year. There is no water being discharged from either of the portals and there is no evidence that there has been any.

The plant composition is made up of a mixture of grasses and shrubs. The following plants were noted at the site: Indian Rice Grass (*Stipa hymenoides),* Crested Wheatgrass (*Agropyron desertorum),* Great Basin Wild Rye (*Elymus cinereus),* Slender Wheatgrass (*Elymus trachycaulus), Woods Rose,* Clematis (*Clematis liqusssticifolia),* Bluestem Wheatgrass (*Agropyron spicatum),* Rabbit brush (*Chrysotahmnus spp.),* Squaw Bush *(Rhus aralmatica var. trrilobata),* Herbaceous sage (*Artemensia spp.),* Willow *(Salix spp.), Mormon Tea (Ephedra spp) and Oregon grape (Mahonia qurfolium).*

Plant vigor was considered fair, the cattle had not grazed the area since spring and had not come down off the mountain yet when these photographs were taken.

Link Canyon West Portal Area



Area adjacent to topsoil pile

Topsoil Storage Pile

Link Canyon Substation, looking up the canyon

LINK CANYON MINE PORTAL

VEGEATION STUDY

Prepared by
Keith W. Zobell
Environmental Specialist
July 16, 2013

Photographs were retaken at the Link Canyon Mine Portal area on June 25, 2013. The area has received limited moisture this spring and winter. Due to low moisture the growth on the perennial plants has been below normal. The area at the West Portal has been heavily grazed by cattle this spring and has made plant measurements difficult and in some cases impossible. Many of the perennial plants have been grazed down to almost ground level and therefore identification could not be made on all the species at the site. There has been some regrowth on a few of the species. There are very few Halogeton (*Halogeton glomeratus)* in the plot, however the roadway leading into the site has a good stand of Halogeton plants. There is no evidence that there has been any overland flow in the adjacent stream bed this year. There is no water being discharged from either of the portals and there is no evidence that there has been any.

Using the ocular estimate method the plant density is approximately 55 percent. This is about the same as it was last year. There are very few annuals, including Halogeton, growing on the site.

The plant composition is made up of a mixture of grasses and shrubs. The following plants were found and measured a the site: (1) Indian Rice Grass (*Stipa hymenoides)* has been heavily grazed and there are no seed heads, there is 4-6 sparse regrowth, (2) Crested Wheatgrass (*Agropyron desertorum)* has been heavily grazed but has a few 10-12 inch seed heads and sparse regrowth 6 inches high, (3) Great Basin Wild Rye (*Elymus cinereus)* has been heavily grazed but has a few 36-48 inch seed heads and 24-36 inches of growth, (4) Slender Wheatgrass (*Elymus trachycaulus)* has been heavily grazed and has a grazed height of less of 1 inch and therefore no measurement could be made, (5) Clematis (*Clematis liqusssticifolia)* continues to invade the lower portion of the site. It has not been grazed and is providing a good ground cover, (6) Bluestem Wheatgrass (*Agropyron spicatum)* has been heavily grazed but has 6-8 of growth with sparse 8-10 inch seedheads, (7) Rabbit brush (*Chrysotahmnus spp.)* has 4-6 in new growth and has had some light grazing, (8) Squaw Bush *(Rhus aralmatica var. trrilobata)* has 4-6 inches of new growth, (9) Herbaceous sage (*Artemensia spp.)* has 9-10 inches of new growth, Annuals including Halogeton are sparse and except for Halogeton have matured and gone to seed. (10) Willow *(Salix spp.)* 4-8 inches of new growth with some light grazing.

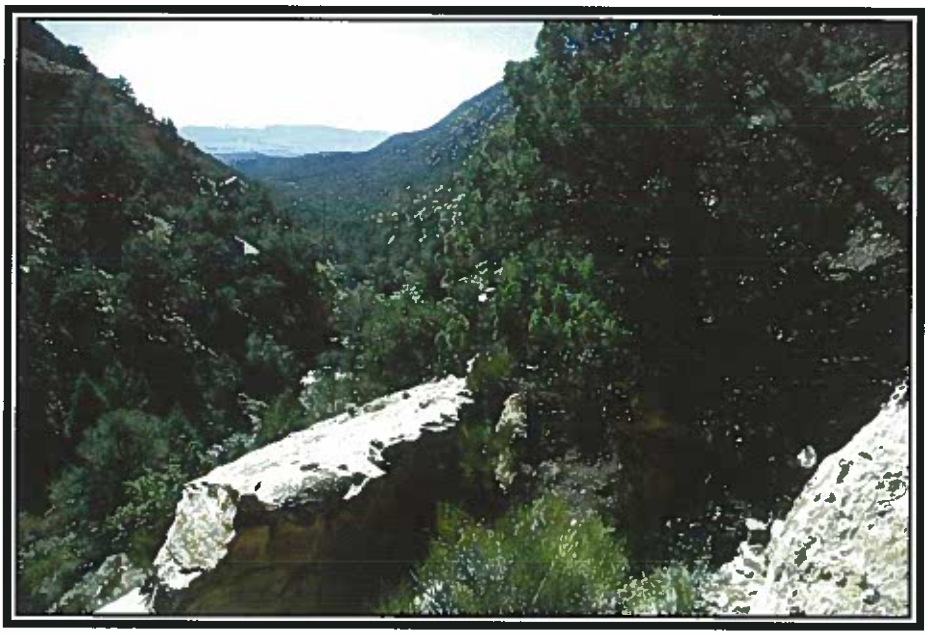
Plant vigor is still considered low fair to poor. The is due to the drought conditions at the site. This site has not been grazed by domestic livestock. Using the ocular estimate method the site has an over-all density of approximately 35 percent. There are a few annual that have matured and gone to seed. The following plants were found and measured at the site" (1) Clematis, continues to invade the site and has good growth and provides good ground cover, (2) Rabbit brush has 4-6 inches of new growth, (3) Indian Rice Grass has good seed production with seed heads 26-28 inches tall and basal growth of 10-12 inches, (4) Willow 4-8 inches of new growth ,(5) Wire Grass (*Juncus spp.)* plants are sparse and have 10-14 inches of growth and are in flower, (6) Bluegrass (*Poa pratensis)* no plants were found, (7) No Slender Wheatgrass plants were found.

There is no water flowing from the portal and no evidence of overland flow.

Link Canyon West Portal Photographic Point

Link Canyon East Portal Photographic Point

Vegetation Monitoring
at the
Link Canyon Portal Area:
An Update
2013



View From the Link Canyon Portal Site

Prepared by

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for

CANYON FUEL COMPANY, LLC
SUFCO MINE
597 South SR 24
Salina, Utah 84654

February 2014

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INTRODUCTION

In 2002, engineers for Canyon Fuel Company designed a new access portal and other minor surface facilities for the SUFCO Mine. The new portal was constructed in Link Canyon at the site of an old portal that was created from earlier mining activities. Construction of the portal created about 1/4 acre of new land disturbance, or more appropriately called re-disturbance.

The portal site in Link Canyon is located in Sevier County, Utah about 7 miles northwest of the town of Emery (GPS coordinates: NAD 27, 12 S, 471190E, 4312294N). Native plant communities at the site consisted primarily of pinyon-juniper and riparian types. Elevation at the site was approximately 7,600 ft above sea level.

The purpose of this document is to provide an update of the vegetation at the Link Canyon Portal site and also to provide recommendations for future studies.

Prior to construction of the new portal, field studies were conducted by *Mt. Nebo Scientific, Inc.* One such study provided a report called: Survey Report, Aquatic Fauna, Link Canyon Portal Area (July 2002). The objectives of this study were to 1) survey for presence of specific sensitive aquatic fauna species and 2) to assess the potential for the habitat to support other sensitive aquatic species. Another field study was conducted that resulted in a report called: Vegetation of the Link Canyon Portal Surface Facilities (August 2002). This study provided information about the plant communities at the site as well as proposed vegetation reference areas that could be used for revegetation success standards when the site is ultimately reclaimed. Information about potential threatened, endangered and sensitive plant species was also provided in that report.

Since the time the portal was constructed, the vegetation has been monitored by Mr. Keith W. Zobell, an environmental specialist. Mr. Zobell's reports provided color photographs at specific locations as well as a qualitative assessments of the vegetation at the Link Canyon Portal site.

METHODS

Field work was conducted at the Link Canyon Portal site on September 18, 2013. The entire disturbed area was surveyed including the portal, its access road, stream buffer zones, culverts and road cut slopes. The reference areas were also visited on that day. Qualitative notes as well as photographs were recorded.

RESULTS

The cover, density, diversity, productivity and vigor of the vegetation at the Link Canyon Portal site were in excellent condition. A list of plant species observed is shown on Table 1. One relevant or telling method of assessing the site it to observe the photographs taken during the field work. The portal site entrance gate is shown in Fig. 1, whereas the access road behind the gate is shown in Fig. 2. Not surprising because the road was not seeded, this is where some "weedy" species were located. The topsoil pile was covered with desirable vegetation (Fig. 3), and is was controlling erosion. Signs have been placed and remain in good condition at the stream buffer boundaries (Figs. 4 and 5). The stream has been protected by these buffer zones. The actual portal entrance is closed to the public by a chainlink gate (Fig. 6). The drainage culverts are clear, the bank around them is stable and has good vegetative cover (Fig. 7). Fig. 8 shows some of the general disturbance area – note the good cover and vigor of the vegetation here too. The access road fill banks have also been stabilized by plant growth, although some of it is comprised of a few weedy plants (Fig. 9). The weeds were a minor component here however, adding to the bank stability and probably not enough to be concerned about implementing weed control measures at this time.

The reference areas, or those communities chosen to represent future revegetation success standards at the time of final reclamation, remain in good condition. The Pinyon-Juniper Reference Area is shown in Fig. 10; the Riparian Reference Area is shown in Fig. 11.

Table 1: Plant species observed at the Link Canyon Portal Site.

SCIENTIFIC NAME	COMMON NAME
Trees & Shrubs	
Betula occidentalis	Water birch
Chrysothamnus nauseosus	Rubber rabbitbrush
Clematis ligusticifolia	White virgins-bower
Cornus sericea	Red-osier dogwood
Ephedra viridis	Mormon tea
Eriogonum corymbosum	Corymb buckwheat
Juniperus osteosperma	Utah Juniper
Pinus edulis	Pinyon-pine
Pseudotsuga menziesii	Douglas fir
Rhus aromatica	Squaw bush
Ribes aureum	Golden current
Rosa woodsii	Wood's rose
Salix exigua	Coyote willow
Forbs	
Aster foliaceous	Leafy-bract aster
Halogeton glomeratus	Halogeton
Grasses & Grass-likes	
Agropyron cristatum	Crested wheatgrass
Elymus cinereus	Gt. Basin wildrye
Elymus smithii	Western wheatgrass
Elymus salinus	Salina wildrye
Juncus arcticus	Wiregrass
Stipa hymenoides	Indian ricegrass

SUMMARY & RECOMMENDATIONS

Over 10 years ago, a new mine portal was constructed at Link Canyon in south-central Utah. The new portal was placed in an area that was once disturbed by another portal from earlier mining operations. In 2002, prior to construction of the new portal, biological studies were conducted to gather baseline information at the site. These studies included aquatic fauna, vegetation and sensitive species work. Following construction of the new portal, the area was seeded and the vegetation has been regularly monitored. Status reports have been provided to the State of Utah, Division of Oil, Gas & Mining (DOGM).

This report provides the general condition of the vegetation at the Link Canyon Portal site in 2013. Vegetation has become well established on the road-cuts, road banks, topsoil pile, culvert bank, stream buffer zones and other disturbed areas. Signs and access gates are also in good condition.

The reference areas previously chosen to represent future revegetation success standards remain in good condition and continue to be viable to be used for comparisons at the time of final reclamation.

Because the vegetation has become well established, has stabilized over-time and remains in good condition with respect to cover, diversity, density and productivity, there appears no practical reason to continue to monitor the site on an annual basis – at least from a vegetation prospective – unless more mine-related disturbance is conducted, or until the time of final reclamation and revegetation.

Fig. 1: Portal Entrance

Fig. 2: Portal Access Road

Fig. 3: Topsoil Pile

Fig. 4: Stream Buffer Zone

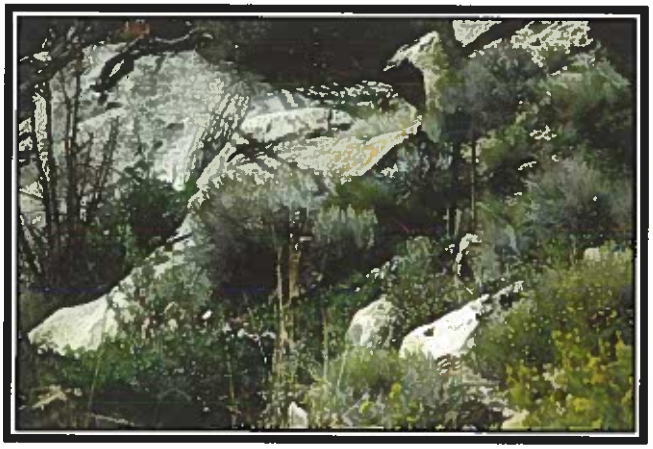


Fig 5: Stream Buffer Zone

Fig 6: Link Canyon Portal

Fig 7: Drainage Culverts

Fig 8: General Disturbance

Fig 9: Road Fill Bank

Fig 10: Pinyon-Juniper Reference Area

Fig 11: Riparian Reference Area

Vegetation Monitoring
at the
Link Canyon Portal Area:
An Update
2013

View From the Link Canyon Portal Site

Comparison of Weather Data and Stream Discharge

At the Sufco Mine During 2013

Introduction

This report provides an analysis and discussion of the relationship between climatic variability and stream discharge rates in the Pines area at the Canyon Fuel Company, LLC, Sufco Mine during 2013. The information used in this analysis includes the information provided herein and information provided previously to the Utah Division of Oil, Gas and Mining.

Climate Data

A National Weather Service weather station (Salina 24E) is operated at the Sufco Mine surface facilities. This weather station is operated year-round and records precipitation amounts (as direct rainfall or as snow-water equivalent). Information from this weather station is used in the flow comparisons presented below. A plot of yearly precipitation at the Salina 24E for the period 1984 to 2013 as percentages of average is presented in Figure 1.

A remote automated weather station was installed in the upper East Fork of Box Canyon in August 2004 that has historically provided seasonal temperature and precipitation data from the area during the non-freezing portion of the year. However, during early 2013 there was a

malfunction with the electronics of the automated data collection system and as a result reliable climate data from the East Fork Weather Station are not available for 2013.

The Palmer Hydrologic Drought Index (PHDI) has also been used in the flow comparisons presented below. A plot of the PHDI for Utah Region 4 is included in this analysis as Figure 2. The PHDI is a monthly numerical value generated by the National Climatic Data Center 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 and surface water discharge.

As reflected in Figure 4, beginning in late 2009, the region began a transition from moderate drought conditions toward wetter than normal conditions that peaked in July 2011 with an extreme wet spell. Beginning in July 2011 and continuing into early 2012, the region experienced decreasing wetness. From May 2012 through the end of that year, the region experienced a continuous period of moderate to severe drought. The drought conditions in the region continued uninterrupted through the first eight months of 2013. Thus, the region experienced a prolonged 16-month period of persistent drought that extended through August of 2013. Beginning in September 2013, the PHDI indicates a rapid transition to mildly wet conditions in response to intense summer monsoonal thunderstorm events the region experienced.

It is apparent in the yearly precipitation data from the Salina 24E station (Figure 1) that dry years have been dominant over wet years in the Sufco Mine area since 2000. Of the previous 14 years, 11 have been dry (shown in red) while only three have been wet (shown in blue). In contrast, during the preceding 15 year period, during 10 of those 15 years precipitation was greater than normal (Figure 1). As indicated on Figure 1, the precipitation measured at the Salina 24E station during the 2012-2013 water year (14.85 inches) was above normal (109% of average) . It is noteworthy that 30% of the year's precipitation fell during a series of thunderstorms that occurred during a single 7-day period in September 2013.

Pines 407

Pines 407 is a surface-water monitoring station on the Main Fork of Box Canyon Creek just above the confluence with the East Fork of Box Canyon (see Figure 3 for location). Discharge data are measured at Pines 407 using a 3-inch Parshall flume that is installed at the site. The site is monitored quarterly for discharge rate and field water quality parameters. Discharge data at Pines 407 for 2013 are plotted together with precipitation data from the Salina 24E Weather Station and PHDI data for Utah Region 4 on Figure 4. Additionally, for the purposes of comparison, discharges from Pines 407 and Pines 408 are plotted together with a plot of the PHDI for Utah Region 4 for the period 2000-2013 in Figure 5.

Discharge measured at Pines 407 during 2013 ranged from 30.8 gpm during September to 39.9 gpm during late October. A discharge of 38.1 gpm was measured during June 2013. The general lack of a pronounced early season discharge peaks observed at this site suggests that either 1) substantial springtime snowmelt runoff events did not occur, or 2) the peak

discharges occurred in the drainage prior to the first monitoring events of the year (usually in June). The discharge rates measured during 2013were somewhat greater than those measured in 2012 (Figure 5). It is noteworthy that immediate responses to previous significant wet spells in the region have generally not been observed at Pines 407 (Figure 5). This observation seems to support the conclusion that the groundwater systems that support baseflow in the creek are likely associated with long groundwater flowpaths, and/or slow groundwater migration rates and appreciable, multi-year groundwater storage in the groundwater system (i.e. a buffered system). Accordingly, large-scale seasonal variability is not generally noted in the discharge at Pines 407 while longer term trends may be apparent. It is seems probable that if persistent wet climatic conditions prevail in the region in the future, baseflow discharge rates in the stream would increase in response to the cumulative effects of increased recharge to the bedrock groundwater systems that supply baseflow to the stream.

Pines 408

Pines 408 is a monitoring station on the East Fork of Box Canyon Creek just above the confluence with the main fork of Box Canyon Creek (see Figure 3 for location). Monitoring site Pines 408 is monitored quarterly for discharge and field water quality parameters. Discharge data at Pines 408 for 2013 are plotted together with precipitation data from the Salina 24E Weather Station and the PHDI for Utah Region 4 in Figure 6. Additionally, for the purposes of comparison, discharges from Pines 407 and Pines 408 are plotted together with a plot of the PHDI for Utah Region 4 for the period 2000-2013 in Figure 5.

The maximum discharge measured at Pines 408 during 2011 (11.1 gpm) occurred on 18 June 2011. This discharge exceeds the maximum 2010 discharge by nearly two gallons per minute. While it is not uncommon for there to be no discharge at Pines 408 during the warm late-summer period, a flow of 4.6 gpm was measured at Pines 408 on 15 September 2011. On 19 October 2011 a discharge of 8.11 gpm was measured at Pines 408, which represents an increase of 3.5 gpm relative to the September measurement. The increase in discharge during October 2011 is likely attributable to decreased evapotranspiration in the stream course during the cool fall season as air temperatures decrease and vegetation along the stream becomes dormant.

In contrast, during 2012, discharge rates measured at Pines 408 were lower than those measured in the much wetter year 2011. Discharge in June 2012 was 0.24 gpm. During early September 2012, there was no measurable discharge at Pines 408, although the stream channel was damp and there were isolated pools in the stream channel, suggesting recent flow in the creek (likely occurring during the nighttime hours when evapotranspiration rates are low). On 17 October 2012 the flow was 3.41 gpm, which was a substantial increase relative to the rates measured during the 2nd and 3rd quarter monitoring events. This increase is likely attributable to decreased evapotranspiration in the stream course during the cool fall season as air temperatures decrease and vegetation along the stream becomes dormant.

During 2013, discharge measured at Pines 408 ranged from no flow on 29 June 2013 to 3.03 gpm in late October (25 October 2013). On 23 September 2013 a discharge of 2.67 gpm was measured. The lack of flow measured during the June monitoring event is likely attributable

to the high evapotranspiration rates occurring during the warm summer season. The increased discharge measured during September and October 2013 is likely due in large part to the decreased rates of evapotranspiration rates during the cool fall season. The appreciable precipitation the region received during September may also have contributed to the increased late-season discharge rates in the lower East Fork of Box Canyon Creek (Figure 6).

FP-1

FP-1 is a monitoring site on a specified reach of the stream channel in the upper west fork of the Main Fork of Box Canyon located between monitoring sites SUFCO 089 and GW-20 (See Figure 3). Monitoring at FP-1 occurs on or near October 1 of each year. Monitoring at FP-1 consists of the identification of the location of the first (uppermost) discharge in the stream on that date. A discharge measurement is also performed at this location. On 25 October 2013 there was no flow in the FP-1 stream section. Likewise, there was no flow in the FP-1 location when the site was visited on 23 September 2013.

The first occurrence of continuous flow in the main fork of Box Canyon Creek on 18 October 2013 occurred at the approximate location as shown on Figure 3. A discharge of 0.22 gpm was measured at that time in the creek a short distance downstream. At locations higher in the stream drainage, zones of intermittent wetness were present during both the 3rd and 4th quarter 2013 monitoring events. The flow measured at FP-1 during 2013 was appreciably greater than that measured in 2012 (0.05 gpm), which is likely attributable to the wetter climatic conditions the region experienced during late 2013.

FP-2

FP-2 is a monitoring site on a specified reach of stream in the North Water Canyon tributary of the East Fork of Box Canyon Creek between Pines 105 and the confluence with the East Fork of Box Canyon Creek (See Figure 3 for location). Monitoring at FP-2 occurs on or near October 1 of each year. Monitoring at FP-2 consists of the identification of the location of the perennial portion of the stream. There was no perennial stream flow at the confluence with the East Fork of Box Canyon Creek when the site was visited on 25 October 2013. The FP-2 site was also dry when it was visited on 23 September 2013.

Pines 106

Pines 106 is a monitoring station which is part of Sufco's regular quarterly water monitoring plan. Pines 106 is located at the approximate location of site EFB-6, which is a flow-only monitoring site on the East Fork of Box Canyon Creek added to the monitoring plan in conjunction with the undermining of the stream with the 3 Left Pines East longwall panel. The location of Pines 106 is approximately coincident with the historical uppermost occurrence of perennial flow in the East Fork of Box Canyon Creek. Above this location, in most reaches the stream has usually been dry historically. Discharge data for Pines 106/EFB-6 as monitored during 2013 are plotted on Figure 7. For comparative purposes, the discharge measured at monitoring station Pines 408 (the lower East Fork at the confluence with the main fork) is also plotted on Figure 7. Also plotted together with the discharge measurements in Figure 7 is a plot of precipitation data from the Salina 24E weather station.

The yearly precipitation data are plotted on Figure 7 as deviations from the long-term (25 year) average precipitation.

No discharge was measured at Pines 106/EFB-6 during 2013. However, discharge continued to be observed in the creek beginning near the nearby EFB-7 location. As indicated above, during previous years, it was common for sustained discharge in the East Fork to begin near the Pines 106/EFB-6 location. The somewhat lower occurrence of the first sustained water in the drainage may be related to subsidence effects associated with mining in the underlying 4 Left Pines East longwall panel (i.e. a local depression of water levels in the shallow groundwater system). However, the fact that sustained perennial stream discharge still occurs a short distance below EFB-6 demonstrates that the surface water has not been entirely diverted away from the site or into deep rock strata underlying the creek.

As discussed previously (See Pines 407 section) an immediate response to the previous significant wet spell that occurred in 2005 was not observed in discharge rates at Pines 407 on the main fork of Box Canyon Creek (Figure 5). This observation seems to support the conclusion that the groundwater systems that support baseflow in the creek at that location are likely associated with long groundwater flowpaths, and/or slow groundwater migration rates and appreciable, multi-year groundwater storage in the groundwater system (i.e. a buffered system). Similar groundwater flow characteristics may be present in the East Fork of Box Canyon area. The sustained, perennial discharges from the bedrock groundwater systems in the East Fork of Box Canyon (below EFB-7) seem to support this conclusion.

Based on this conceptual model, it could be concluded that the rapid response to the 2005 climatic event may indicate that storage in the bedrock groundwater system just prior to the 2005 event may have been greater than it was prior to the 2011 event. Whether the differences in the volume of groundwater potentially held in storage in the bedrock groundwater system during these two events could be related to subsidence-related effects is not known.

Based on this conceptual model, at a time when persistent wet climatic conditions prevail in the region in the future, baseflow discharge rates in the stream may increase correspondingly in response to the cumulative effects of increased recharge to bedrock groundwater systems. Accordingly, using future discharge monitoring data from the East Fork, it should be possible to determine whether variability in the discharge rates in the stream is attributable to long-term climatic variability or to other factors. We recommend that monitoring of stream discharge rates at Pines 407, Pines 408, and Pines 106 in the Box Canyon Creek drainage be continued during 2014.

USFS 109

USFS 109 is routinely monitored as part of Sufco's quarterly water monitoring program. The site is located in the upper middle fork of the Main Fork of Box Canyon. There was no discharge measured during 2013 at USFS 109.

USFS 110

USFS 110 is routinely monitored as part of Sufco's quarterly water monitoring program. The site is located in the upper main fork of Box Canyon Creek. There was no discharge measured during 2013 at USFS 110.

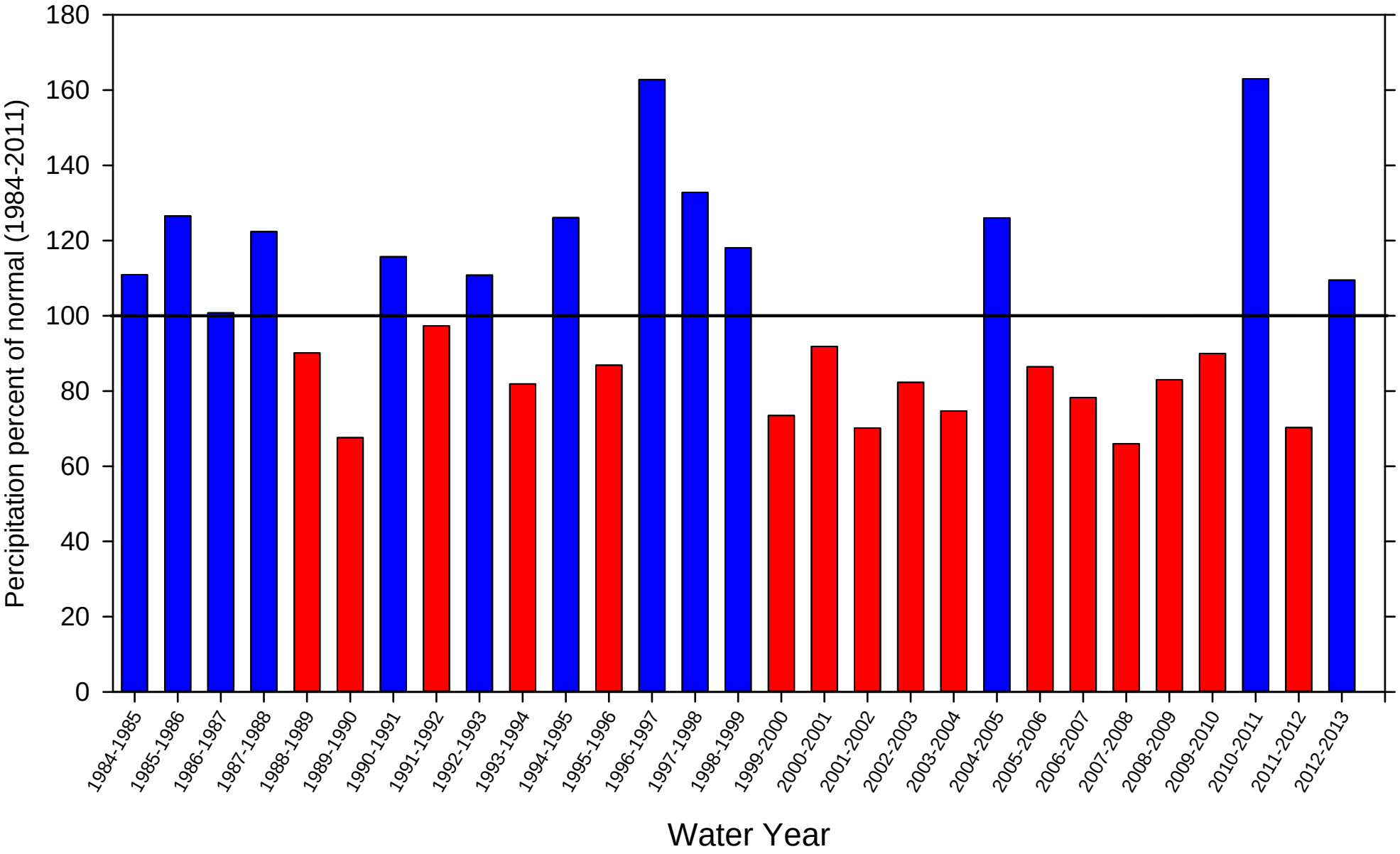
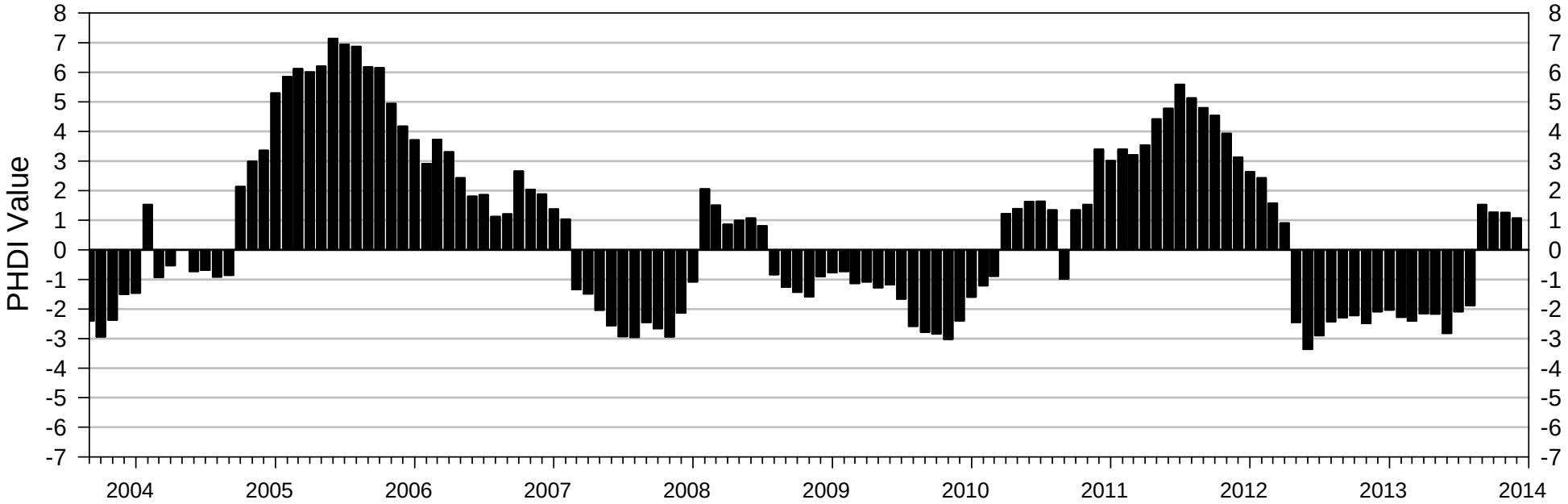


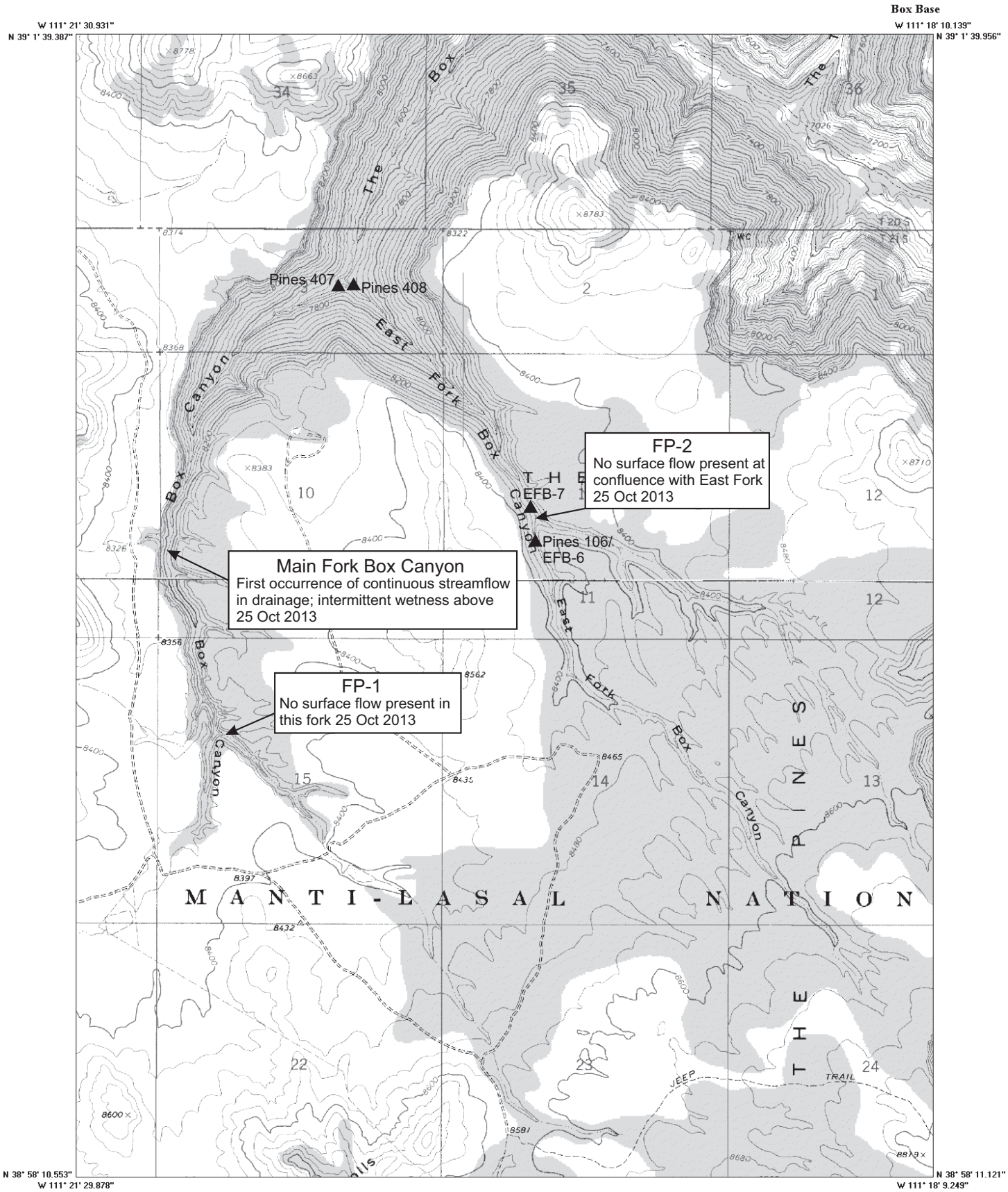
Figure 1 Sufco Mine Weather Station Precipitation.



-1 to -2 Mild Drought
-2 to -3 Moderate Drought
-3 to -4 Severe Drought
-4 to -5 Extreme Drought

1 to 2 Mild Wet Spell
2 to 3 Moderate Wet Spell
3 to 4 Severe Wet Spell
4 to 5 Extreme Wet Spell

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



1927 North American Datum; 1,000-meter UTM grid zone 12
Generated by BigTopo (www.igage.com)
Map compiled from USGS 7½ Minute Quads: Flagstaff Peak; UT Emery West; UT

0 ¼ ½ 1 Mile
0 1000 2000 3000 4000 5000 Feet
0 0.5 1 Kilometer

Figure 3 Stream locations.

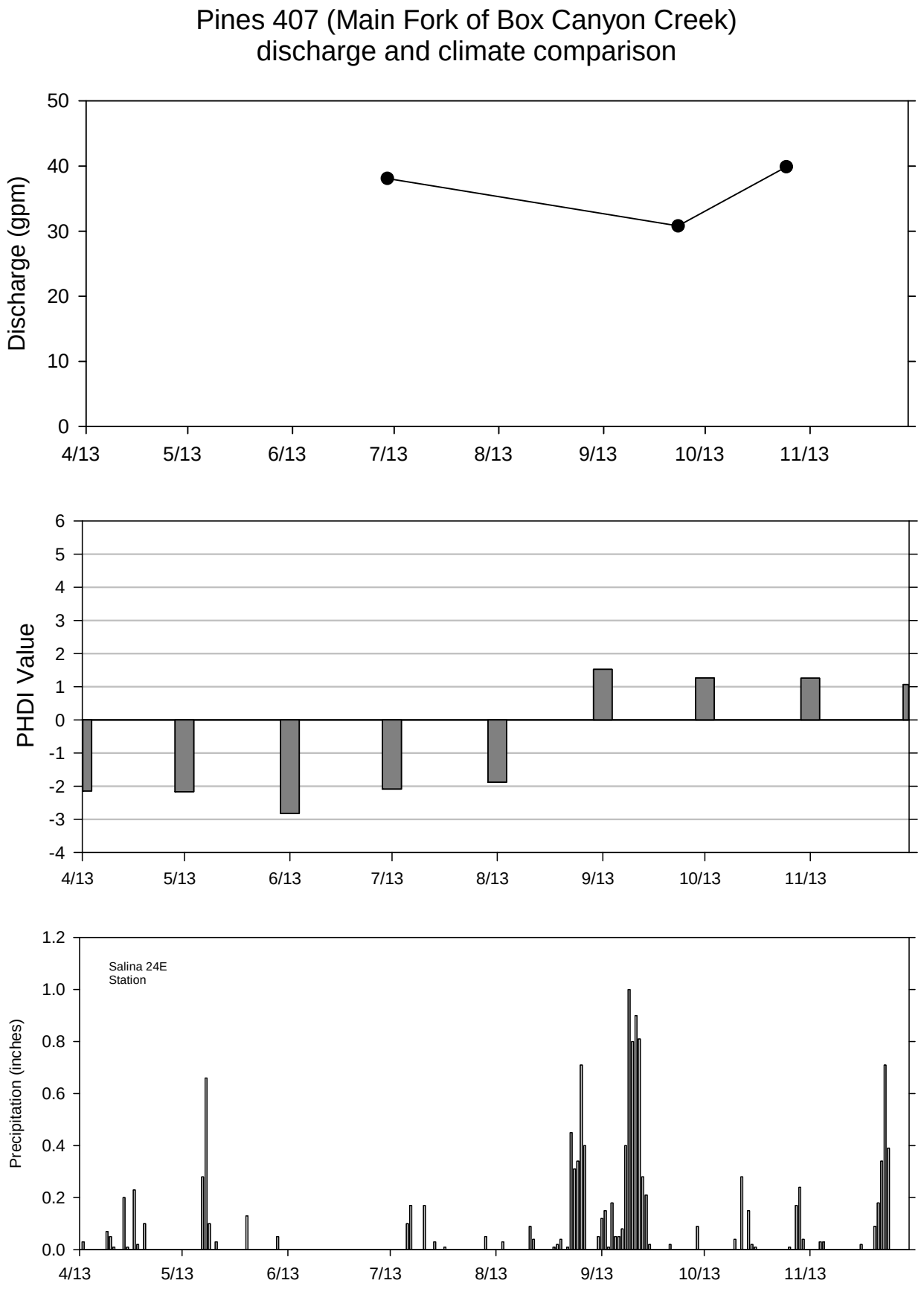


Figure 4 Pines 407 discharge and climate comparison.

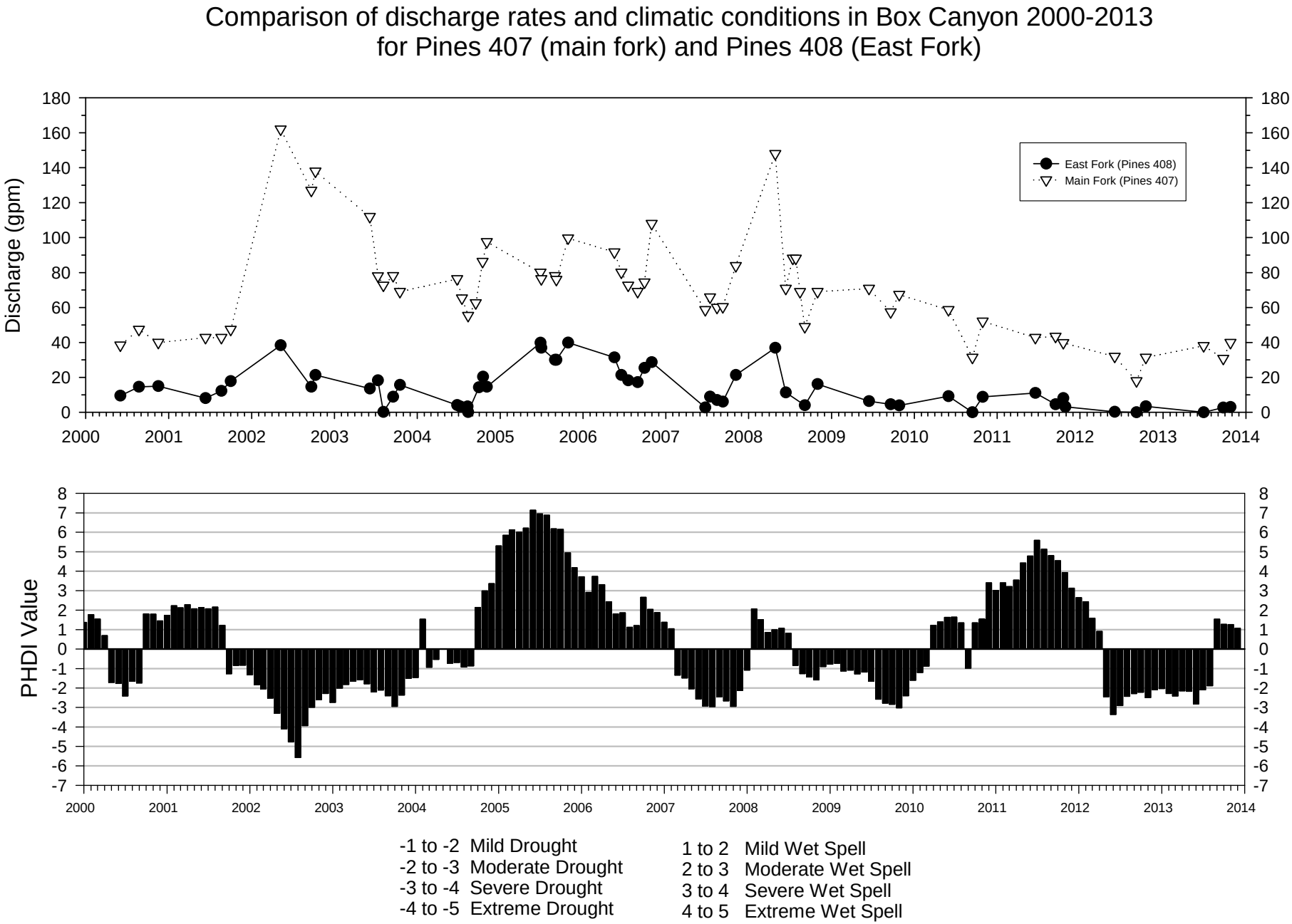


Figure 5 Discharge hydrographs for Pines 407 and Pines 408 and PHDI for Utah Region 4.

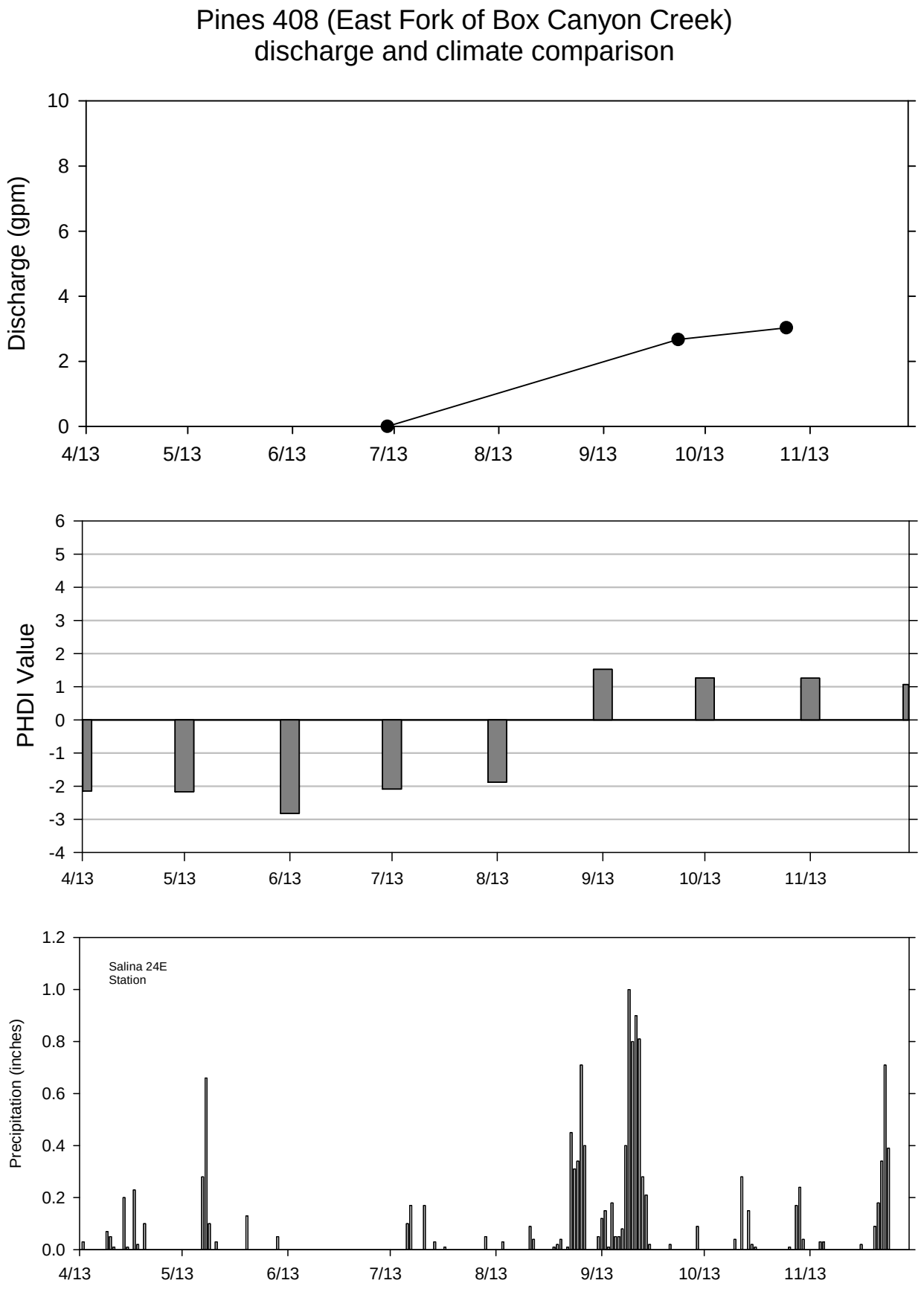


Figure 6 Pines 408 discharge and climate comparison.

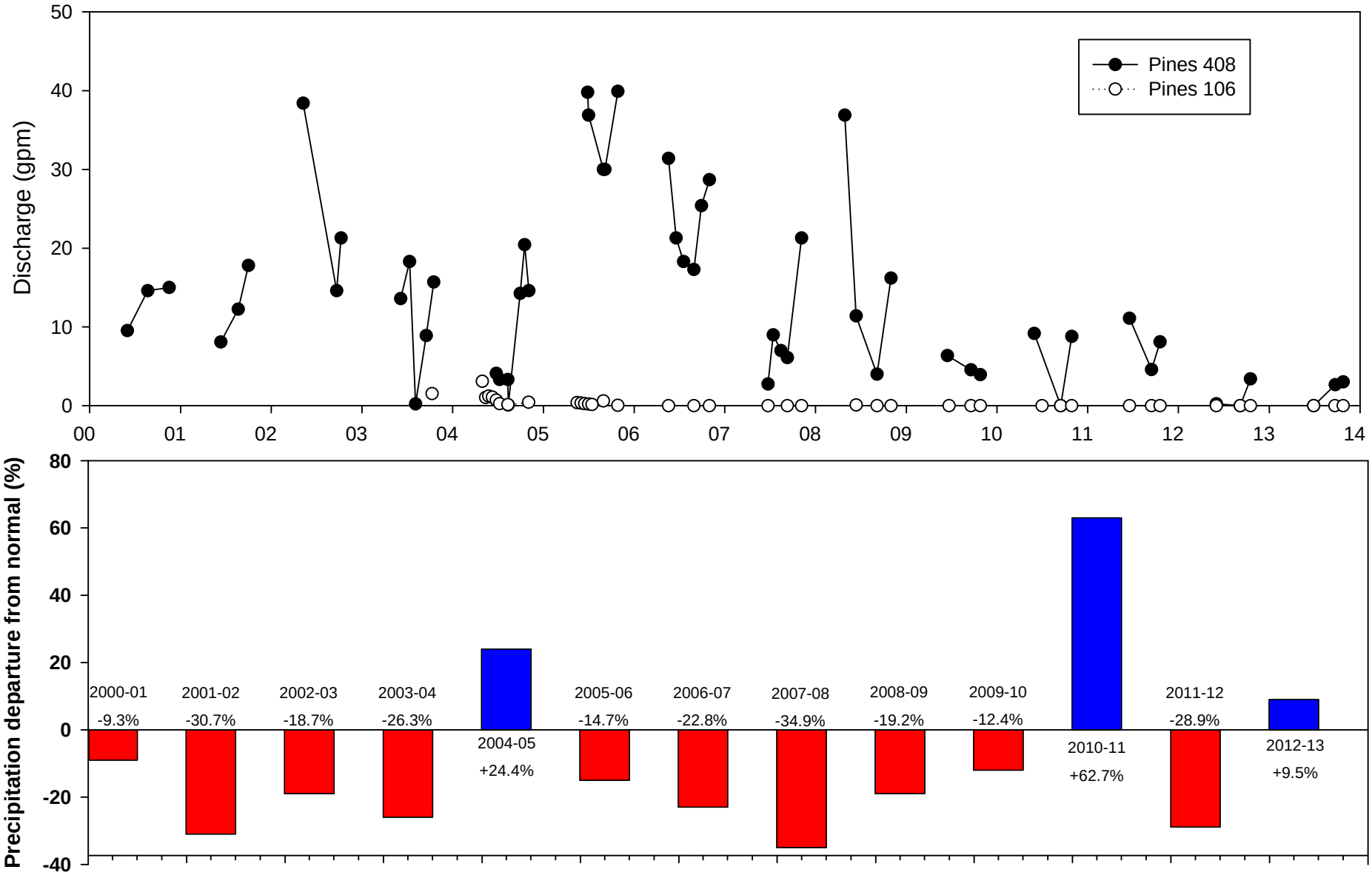


Figure 7 Pines 408 and Pines 106 discharge and Sufco Mine weather station data 2000-2013.

INFRARED COMPARISION – 2013

Appendix 3-15
Sufco Mine
Explanation of Vegetation Change per Infrared Photography 2008 - 2013

Infrared photography was used to provide the condition of vegetation for evaluation over the five-year period from August/September of 2008 through August/September of 2013.

Using the USGS VegDRI animated time series the vegetation drought conditions for the area surveyed by Sufco (shown on the infrared photos) were checked at the end of September for the years 2008 through 2013. Conditions were as follows:

Year	**Vegetation Condition End of September**
2008	Moderate drought
2009	Moderate to Severe drought
2010	Near Normal
2011	Near Normal
2012	Pre-drought
2013	Moderate drought

Year	**Annual Precipitation % of Normal** (USGS)
2008	0.63
2009	0.91
2010	0.78
2011	0.83
2012	0.85
2013	0.75

From this information it should be noted that in both 2008 and 2013 when the infrared photos were taken in August/September the vegetation in the area was considered to be in the condition of a moderate drought.

Although in 2009 the vegetation condition was defined as moderate to severe, the precipitation during the year brought the 2010/2011 condition up to near normal.

Conclusion

The vegetation in the 2013 photo appears to be in similar condition if not better condition than the vegetation in the 2008 photo. The majority of the stock ponds in the 2013 photo had water in them, while in the 2008 photo only a few contained water. In August and September of 2013, it rained 30 of the 61 days at the Sufco mine site which would account for the ponds having water in them and likely the condition of the vegetation looking better. In 2008 it only rained 8 days of the 61 days.

The vegetation in the monitoring area was in moderate drought condition (VegDRI) overall and the precipitation averaged 0.79% of normal over the period evaluated. The average annual precipitation in the area ranges from 10 to 17 inches depending upon the elevation.

Wednesday, February 05, 2014

National Drought Mitigation Center

Monitoring Tools VegDRI

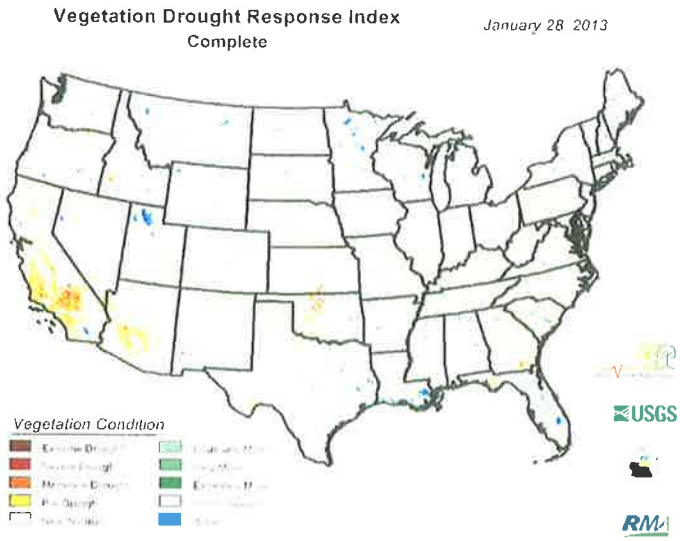
Login

Vegetation Drought Response Index (VegDRI)

The Vegetation Drought Response Index, or VegDRI, is a bi-weekly depiction of vegetation stress across the contiguous United States. VegDRI is a fine resolution (1-km²) index based on remote sensing data, but unlike other satellite-based measurements, VegDRI also incorporates climate and biophysical data to determine the cause of vegetation stress.

VegDRI began in 2006 with coverage available to only seven states in the Northern Great Plains (CO, KS, MT, NE, ND, SD, and WY). In 2007 that coverage expanded to include eight additional states in the Great Plains and Upper Midwest. VegDRI coverage expanded westward in 2008, and eastward in 2009. It now covers all states in the lower 48.

Development of the VegDRI map and associated products is a joint effort by the National Drought Mitigation Center (NDMC), the U.S. Geological Survey's National Center for Earth Resources Observation and Science (EROS), and the High Plains Regional Climate Center (HPRCC). More information and maps can be found at http://gisdata.usgs.net/website/Drought_Monitoring/.



Integrating Data

Remote sensing data is combined with climate and biophysical data to create VegDRI. This integrated approach provides benefits over satellite-derived data alone. Multiple factors such as climate, pests, land use change, fire, and extreme weather events can influence vegetation conditions, so including climate and biophysical data helps distinguish stress due to drought.

Two variables related to general vegetation conditions – the Percent Average Seasonal Greenness (PASG) and Start of Season Anomaly (SOSA) – are calculated from satellite-based observations and incorporated into the VegDRI. Both variables are calculated from normalized difference vegetation index (NDVI) data acquired by NOAA's Advanced Very High Resolution Radiometer (AVHRR). Climate-related variables incorporated into VegDRI include the Palmer Drought Severity Index (PDSI) and the Standardized Precipitation Index (SPI). Information about soils, land cover, land use, and the ecological setting are the types of biophysical data incorporated into VegDRI. This information is critical because the climate-vegetation response can vary depending on these different environmental characteristics.

Evaluating the Map

No single measure can be used to assess the accuracy (both quantitatively and qualitatively) of the VegDRI because of the varying definitions of drought. As a result, a variety of information sources are reviewed to evaluate VegDRI's performance and accuracy.

Periodic feedback from experts, agricultural producers, and others in the general public are used to characterize the general strengths and weaknesses of VegDRI and highlight specific locations or trends that might be in error.

VegDRI is quantitatively compared USDA crop yield data as well as biophysical and soil moisture measurements. The spatial and temporal patterns in the VegDRI maps are qualitatively compared to drought patterns depicted in the U.S. Drought Monitor maps and to the spatial distribution, type, and frequency of drought impacts being reported in the Drought Impact Reporter.

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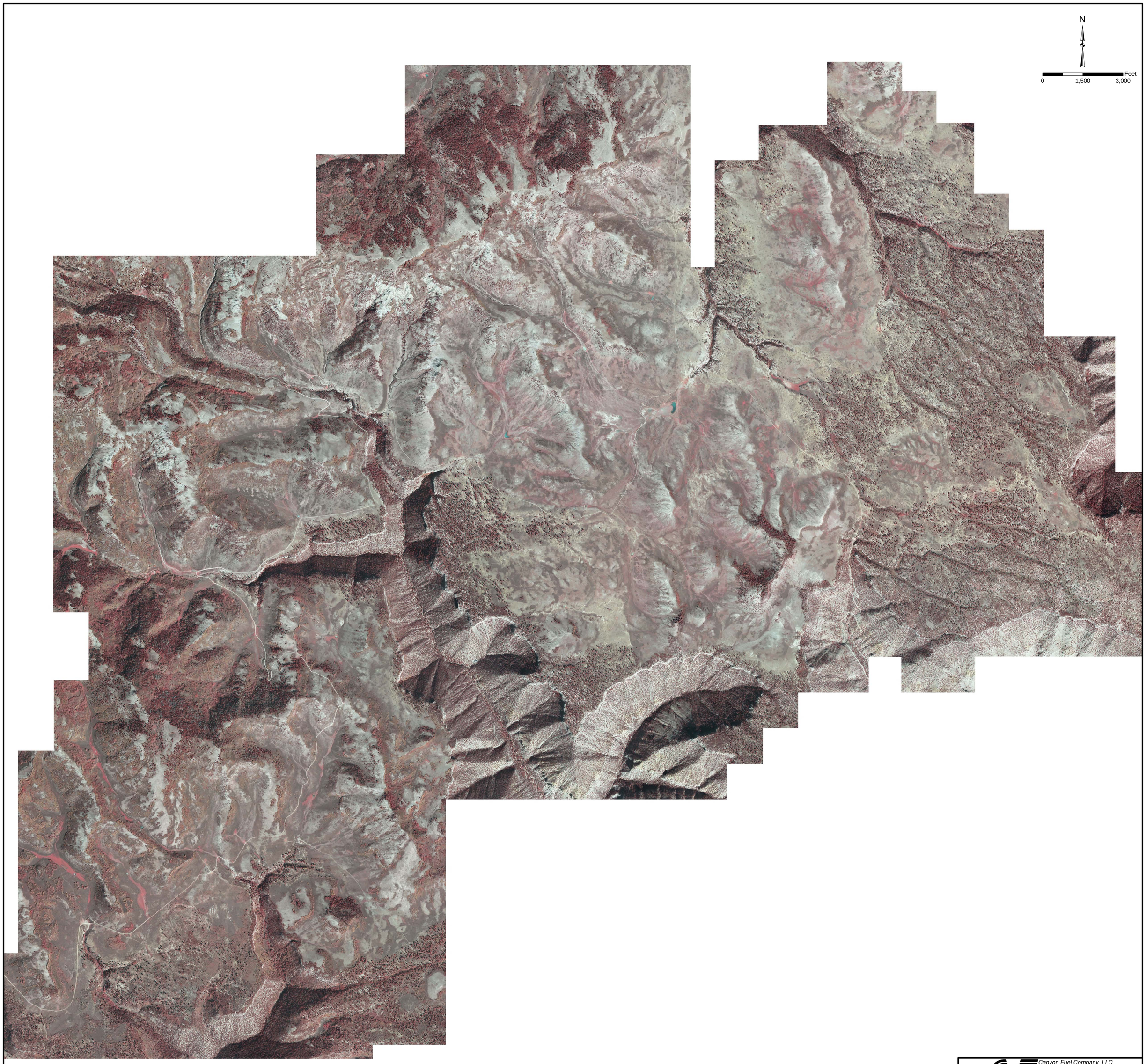
SUFCO MINE

2008 CIR IMAGERY

SCALE:	DATE:	DRAWN BY:	CHECKED BY:	PROJ:	SHEET NO:
1 " = 1,500 '	11/18/2013	T.R.B.	V.L.M.	.	1

FILE NAME: E:\GIS\MAPS\SURFACE\CIR.mxd



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SUFCO MINE

2013 CIR IMAGERY

SCALE:	DATE:	DRAWN BY:	CHECKED BY:	PROJ:	SHEET NO:
1 " = 1,250 '	11/18/2013	T.R.B.	V.L.M.	.	1

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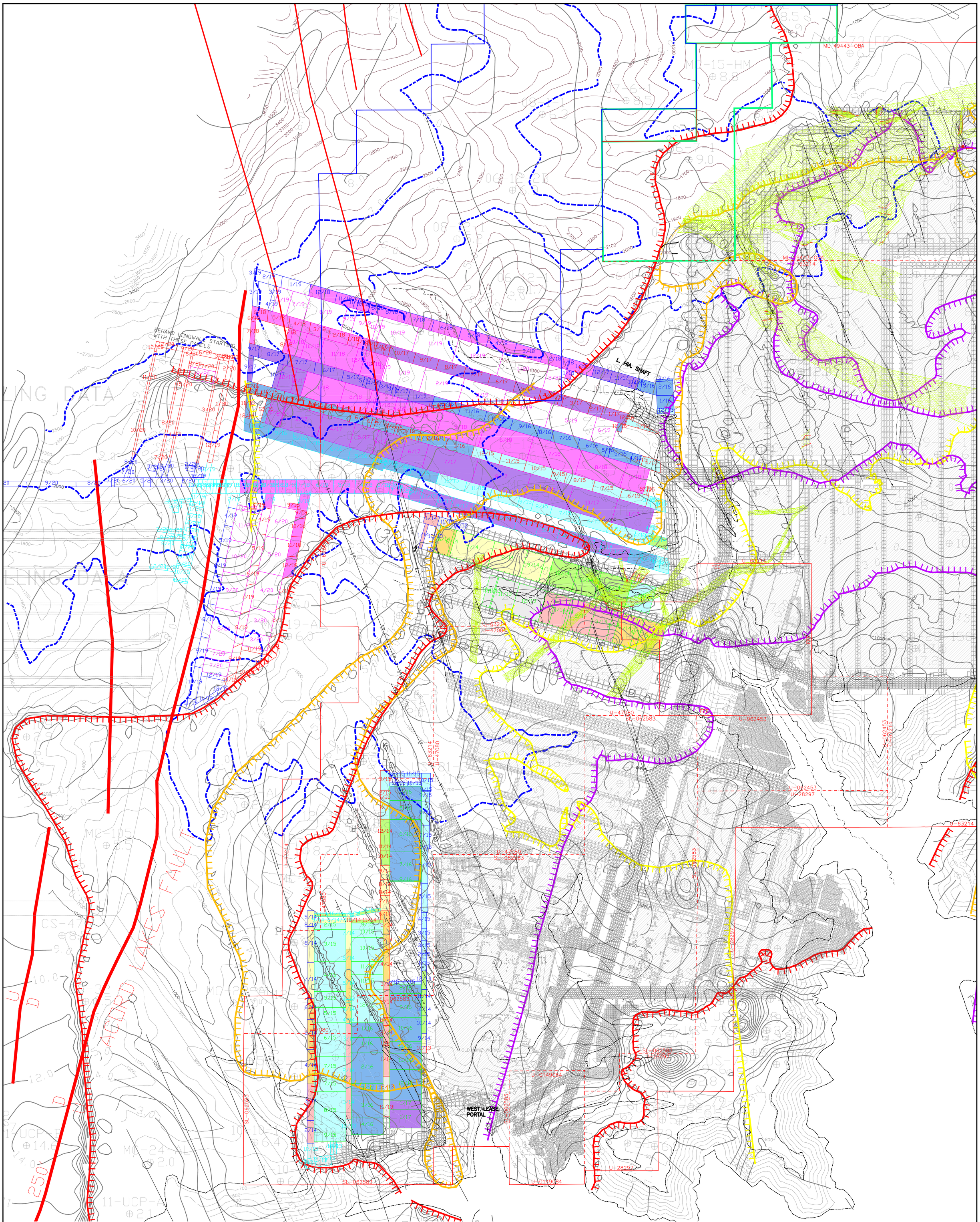
REHAND LONGWALL STARTING WITH THESE PANELS
L HIA. SHAFT
WEST LEASE PORTAL
ACORD LAKE FAULT
U-47080
U-63214
U-062453
U-28297
SL-062583
U-0149034
ML-49443-OBA
MINING LEGEND
REMAINING 2013
1ST QUARTER 2014
2ND QUARTER 2014
3RD QUARTER 2014
4TH QUARTER 2014
2015
2016
2017
2018
MINED-OUT AREAS
STREAM
ESCARPMENT
OUTCROP
FAULT/W PROJECTION
SEAM THICKNESS
OVERBURDEN DEPTH
PRESENT LEASES BOUNDARY
PRESENT LEASES INTERIOR DIVISIONS
GREENS HOLLOW LEASE BOUNDARY
SITLA LEASE LOWER HIAWATHA BOUNDARY
LOWER HIAWATHA SEAM PLYS
UPPER HIAWATHA SEAM BENCH 1
ORANGE PARTING (0.5 FT LINE)
LOWER HIAWATHA SEAM BENCH 3
RED PARTING (0.5 FT LINE)
LOWER HIAWATHA SEAM BENCH 2
PURPLE PARTING (0.5 FT LINE)
LOWER HIAWATHA SEAM BENCH 1
NOTE: TICKS ON THICKENING SIDE OF PARTING
UPPER HIAWATHA PARTING LOCATIONS
REVISIONS OR UP-DATES
NO. DATE BY
DATE: SEPT 21, 2013
DESIGNED BY:
DRAWN BY: JMB
CHECKED BY:
SCALE: 1" = 1000'
Canyon Fuel Company, LLC
SUFCO Mine
SUFCO MINE PLAN
2014 Budget Basecase (WWUH)
397 SOUTH 800 WEST
SALINA, UTAH 84654
DRAWING OR MAP NUMBER
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2013 SUBSIDENCE REPORT

CANYON FUEL COMPANY, LLC

SUFCO MINE

by

Trenton R. Brown

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INTRODUCTION

Canyon Fuel Company LLC, SUFCO Mine's 2013 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. The westerly modifications of Lease U-63214, Lease U-47080, and Lease SL-062583 were flown in 2011.

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.

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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 in a continuous miner panel 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 1,110 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 to 6 feet in the center of the panels. The overburden thickness has been from 1,000 feet to 1,800 feet (except outside the escarpment where overburden rapidly decreases). The maximum measured subsidence caused by longwall mining until 2009 was 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. In 2009 there was a small area on the north end of the last longwall panel in area 12 that maximum subsidence measured nine feet. This area has overburden of approximately 900 feet, and is relatively close to the escarpment.

DORMANT AND ACTIVE AREAS

Dormant areas are those areas that have shown little or no movement for several consecutive years. Yearly digitizing of these areas will not be done, but photographic coverage can be obtained should the need 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.

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2013 SUBSIDENCE

The 2012 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 has not been digitized since 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

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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 failure 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

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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 since 2001, 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 since 2003 and is 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, and gateroad development began in March 2000. Longwall mining began in September 2001 and ended in February 2007. There has been no significant movement detected in this area since 2007. This area appears to have stabilized and is considered dormant.

AREA 13

Area thirteen is a longwall mining block that originally consisted of seven panels on lease U-63214 and lease ML 49443-OBA. Due to a mine plan change near the end of 2008, this area now consists of eight longwall panels. 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 began in March 2007 and ended in 2012.

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This area was considered active in 2007 and will continue to be monitored for several years.

AREA 14

Area 14 consists of a short, single longwall panel on lease U-63214. An elevation baseline for this area was originally established in 1991, and the area was re-flown and checked for any discrepancies in 2011. Gateroad development began in 2010 and was completed in 2011. Longwall mining began and ended in 2012. This area is currently active and will continue to be monitored for several years.

AREA 15

Area 15 is a longwall mining area on lease U-63214, lease U-47080, and fee land. The previous mine plan included two panels. Due to a mine plan change in 2012, a third panel was added that extended into what was Area 17. Upon approval for the third panel, the boundary for Area 15 was adjusted North, to include the third panel. Gateroad development in this area began in 2010. Longwall mining began in 2012. Base elevation data for this area was partially obtained in previous years, but was completely flown and checked in 2011.

AREA 16

Area 16 is a longwall mining block currently planned for 3 panels. The westerly modifications of lease U-63214, lease U-47080, and lease SL-062583 for this area were obtained in 2009. Rehab of existing mine entries and development of gateroads began in 2011, and longwall mining is scheduled to begin in 2014. An elevation baseline for this area was obtained in 2011.

AREA 17

Area 17 is a planned longwall mining block on lease U-63214, and future lease modifications and acquisitions. Gateroad development is scheduled to begin in 2014 and longwall mining will be dependant on future lease holdings. An elevation baseline was obtained for the current mine plan area in 2011.

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

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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. These cracks were checked in 2005 and again for the final time in 2008 and show no significant change in width or displacement.

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.

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CONCLUSION

Areas 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12, are all considered to be dormant. Photographic coverage for these areas can be obtained if circumstances deem it necessary. Longwall mining in Area 13 and Area 14 was completed in 2012 with a maximum subsidence detected to date of 7 feet in Area 13 and 5 feet in Area 14. Yearly monitoring of Area 13 and Area 14 will continue until it is determined that subsidence has ceased. Longwall mining in Area 15 is active. Subsidence monitoring will continue for this area.

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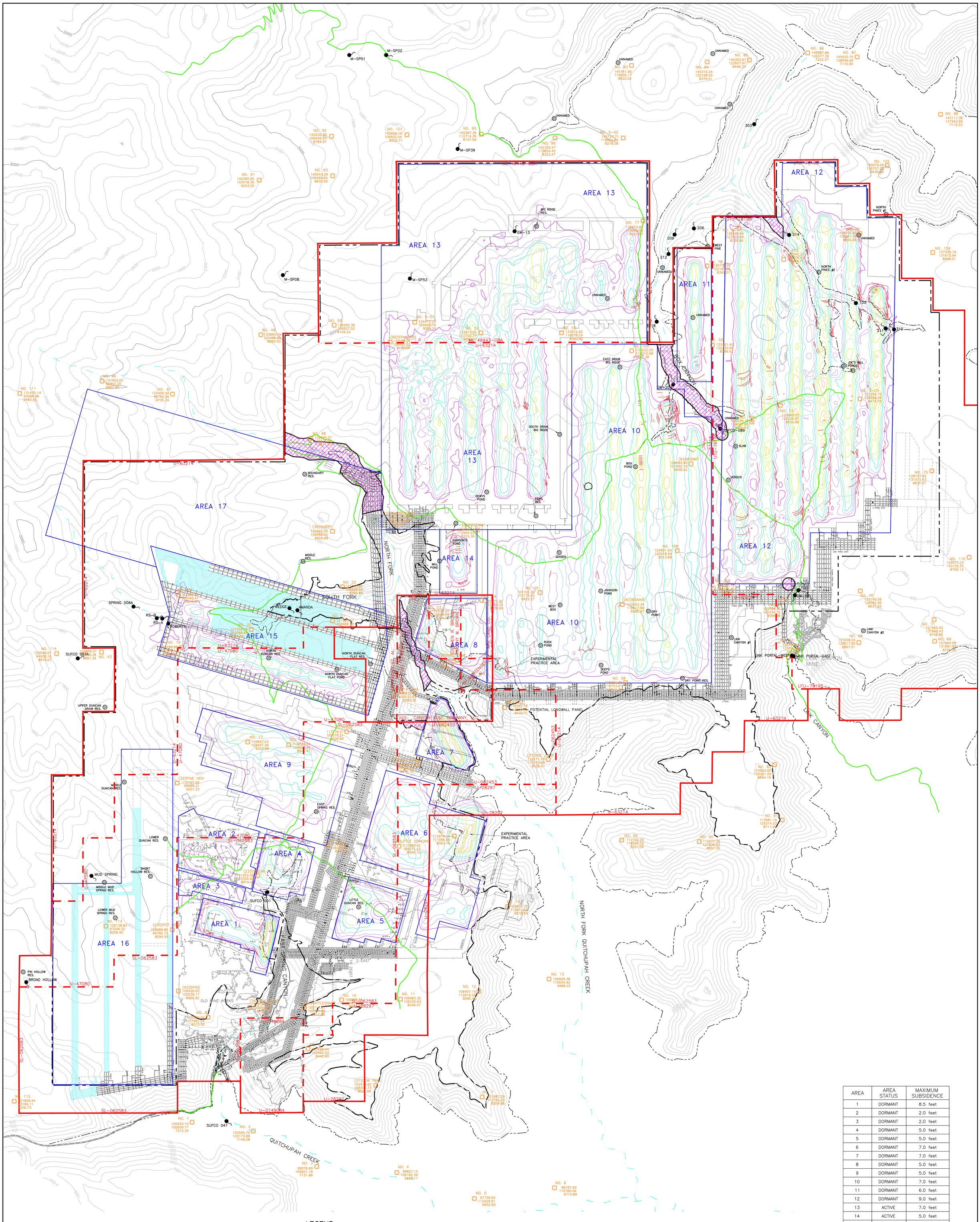

AREA	AREA STATUS	MAXIMUM SUBSIDENCE
1	DORMANT	8.5 feet
2	DORMANT	2.0 feet
3	DORMANT	2.0 feet
4	DORMANT	5.0 feet
5	DORMANT	5.0 feet
6	DORMANT	7.0 feet
7	DORMANT	7.0 feet
8	DORMANT	5.0 feet
9	DORMANT	5.0 feet
10	DORMANT	7.0 feet
11	DORMANT	6.0 feet
12	DORMANT	9.0 feet
13	ACTIVE	7.0 feet
14	ACTIVE	5.0 feet
15	ACTIVE	6.0 feet
16	UN-MINED	N/A
17	UN-MINED	N/A

LEGEND

- COAL OUTCROP
- 600 OVERBURDEN CONTOUR
- PERENNIAL STREAM
- ESCARPMENT
- FOREST ACCESS ROAD
- TENSION CRACKS
- SUBSIDENCE LIMITS
- U-28297 EXTERIOR LEASE LINE
- SL-062583 INTERIOR LEASE LINE
- AERIAL TARGET
- S-18 DRAW ANGLE
- 4L50 SURVEY STATION
- -1' SUBSIDENCE CONTOUR
- -2' SUBSIDENCE CONTOUR
- -3' SUBSIDENCE CONTOUR
- -4' SUBSIDENCE CONTOUR
- -5' SUBSIDENCE CONTOUR
- -6' SUBSIDENCE CONTOUR
- -7' SUBSIDENCE CONTOUR
- -8' SUBSIDENCE CONTOUR
- -9' SUBSIDENCE CONTOUR
- PERENNIAL STREAM BUFFER ZONE
- ONE YEAR PROJECTION
- MONITORED SPRING
- RUNOFF POND

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PROFESSIONAL LAND SURVEYOR #6423494-2201 KEITH B. BIGELOW STATE OF UTAH

REVISIONS

NO.	DATE	REQ. BY	DWG. BY	REMARKS
17	03-07-07	JMB	JMB	ANNUAL UPDATE
18	03-14-08	KBB	KBB	ANNUAL UPDATE
19	01-31-09	KBB	KBB	ANNUAL UPDATE
20	11-30-09	KBB	KBB	ANNUAL UPDATE
21	12-15-10	KBB	KBB	ANNUAL UPDATE
22	11-14-11	KBB	KBB	ANNUAL UPDATE
23	09-30-12	KBB	KBB	ANNUAL UPDATE
24	12-13-13	TRB	TRB	ANNUAL UPDATE

Canyon Fuel Company, LLC
SUFCO Mine
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Sufco Mine Subsidence Map

PEN TBL:	SCALE:	DATE:	DRAWN BY:	ENGINEER:	CHECKED BY:	SHEET NO.
_1Stndrd-SUFENP1.ctb	1" = 1200'	12/13/2013	K.B.B./T.R.B.		K.B.B.	Map 1
SHT SET: ####	PROJECT NUMBER: ####	FILE NAME: H:\DRAWINGS\MRP\Subsidence\SUBSIDMAP\dwg\SUBSIDMAP.dwg				

Trent Brown 3/21/2014 7:39 AM