

July 13, 2016

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: Amendment to MRP to add Monitoring Data and Revise Monitoring Commitments, Sufco Mine,  
Canyon Fuel Company, LLC, Permit Number C/041/0002

Dear Sirs:

Please find enclosed with this letter an amendment to the Sufco Mine Permit to address the addition of  
Vegetation Monitoring Data and the plan to discontinue monitoring associated with subsidence in areas  
along the South Fork of Quitchupah Creek.

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

CANYON FUEL COMPANY, SUFCO Mine

  
for

Kenneth May  
General Manager

Encl.

cc: DOGM Correspondence File

RECEIVED

JUL 14 2016

DIV. OF OIL, GAS & MINING

# APPLICATION FOR COAL PERMIT PROCESSING

Permit Change  New Permit  Renewal  Exploration  Bond Release  Transfer

**Permittee:** Canyon Fuel Company, LLC

**Mine:** Sufco Mine

**Permit Number:** C/041/0002

**Title:** Amendment to MRP to add Monitoring Data and Revise Monitoring Commitments

**Description,** Include reason for application and timing required to implement:

**Instructions:** If you answer yes to any of the first eight (gray) questions, this application may require Public Notice publication.

- Yes  No 1. Change in the size of the Permit Area? Acres: \_\_\_\_\_ Disturbed Area: \_\_\_\_\_  increase  decrease.
- Yes  No 2. Is the application submitted as a result of a Division Order? DO# \_\_\_\_\_
- Yes  No 3. Does the application include operations outside a previously identified Cumulative Hydrologic Impact Area?
- Yes  No 4. Does the application include operations in hydrologic basins other than as currently approved?
- Yes  No 5. Does the application result from cancellation, reduction or increase of insurance or reclamation bond?
- Yes  No 6. Does the application require or include public notice publication?
- Yes  No 7. Does the application require or include ownership, control, right-of-entry, or compliance information?
- Yes  No 8. Is proposed activity within 100 feet of a public road or cemetery or 300 feet of an occupied dwelling?
- Yes  No 9. Is the application submitted as a result of a Violation? NOV # \_\_\_\_\_
- Yes  No 10. Is the application submitted as a result of other laws or regulations or policies?  
*Explain:* \_\_\_\_\_
- Yes  No 11. Does the application affect the surface landowner or change the post mining land use?
- Yes  No 12. Does the application require or include underground design or mine sequence and timing? (Modification of R2P2)
- Yes  No 13. Does the application require or include collection and reporting of any baseline information?
- Yes  No 14. Could the application have any effect on wildlife or vegetation outside the current disturbed area?
- Yes  No 15. Does the application require or include soil removal, storage or placement?
- Yes  No 16. Does the application require or include vegetation monitoring, removal or revegetation activities?
- Yes  No 17. Does the application require or include construction, modification, or removal of surface facilities?
- Yes  No 18. Does the application require or include water monitoring, sediment or drainage control measures?
- Yes  No 19. Does the application require or include certified designs, maps or calculation?
- Yes  No 20. Does the application require or include subsidence control or monitoring?
- Yes  No 21. Have reclamation costs for bonding been provided?
- Yes  No 22. Does the application involve a perennial stream, a stream buffer zone or discharges to a stream?
- Yes  No 23. Does the application affect permits issued by other agencies or permits issued to other entities?

**Please attach four (4) review copies of the application. If the mine is on or adjacent to Forest Service land please submit five (5) copies, thank you.** (These numbers include a copy for the Price Field Office)

I hereby certify that I am a responsible official of the applicant and that the information contained in this application is true and correct to the best of my information and belief in all respects with the laws of Utah in reference to commitments, undertakings, and obligations, herein.

KENNETH E. MAY Kenneth E May 7/13/16  
 Print Name Sign Name, Position, Date

Subscribed and sworn to before me this 13 day of July, 2016

Jacquelyn Nebeker  
 Notary Public  
 My commission Expires: \_\_\_\_\_, 20\_\_ }  
 Attest: State of \_\_\_\_\_ } ss:  
 County of \_\_\_\_\_ }



<b>For Office Use Only:</b>    	<b>Assigned Tracking Number:</b>   	<b>Received by Oil, Gas &amp; Mining</b>   
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**CHAPTER 3**

**BIOLOGY**

adversely impact the perennial vegetation associated with the creek. The overburden between the coal seam to be mined and the stream channel in the tract is between 1100 and 1600 feet. The underlying formations contain rock types that would be expected to easily heal surface cracks that form beneath the stream channel. Additionally, the alluvium within the stream channel supporting riparian vegetation is derived from the fine-grained rocks of the Price River and North Horn formations. This alluvium is expected to naturally readily fill fractures that may occur in the channel substrate thus limiting the loss of flow, if any, supporting the riparian vegetation.

Though not anticipated, short segments of Cowboy Creek could be subsided in the SITLA Muddy Tract. If this is anticipated to occur, Sufco, with the approval of the Division and concurrence of the Forest, will instigate a vegetation monitoring and mitigation plan similar to the plan implemented prior to the undermining of the East Fork of Box Canyon. If mitigation of surface cracks is required, methods similar to those proposed and implemented in the East Fork of Box Canyon as described in Chapter 5 Section 5.2.5.1 and Chapter 7 Section 7.3.1.8 will be used.

The monitoring and mitigation plan for undermining the South Fork of Quitcupah 2R2S Block "A" and 3R2S Block "B" is located in Appendix 3-14. Appendix 3-14 contains a Threatened, Endangered and Sensitive survey prepared by Mt. Nebo Scientific and an assessment of the macroinvertebrates in the South Fork of Quitcupah Creek. The macroinvertebrate assessment was prepared by Dennis K. Shiozawa, Ph.D., which contains the results of a series of benthic samples taken to determine the diversity of the invertebrate community in the South Fork of Quitcupah Creek. In 2016 a summary monitoring report for the upper reaches (sites Q01 - Q09) of the riparian plant community was compiled for of the South Fork of Quitcupah Creek. The report summarizes the data gathered from 2012 thru 2015. The riparian vegetation sample stations in the South Fork were chosen by a team of experts from various agencies (see methods section within the reports). The stations included both control and sampling sites, one being outside the zone of subsidence and the other being within. It should be noted that one control spring area was impacted in the Fall of 2015, it appears that the spring had been dug out to create a water hole for cattle, consequently the spring consists of a 6 foot diameter pool with almost no riparian vegetation and muddy banks. A second impact to the area was a control burn by the Forest Service on the slopes adjacent to the creek also in 2015, due to the burn and verbal communications with the

Division it was decided to end the sampling in 2015 in the upper reaches. According to the report summary "there seemed to be no clear differences in the riparian width trends for the control stations or the subsidence zone stations, Moreover, there were also no clear differences in the trends in the springs when compared channel sites in either the control or the subsidence zone stations. -----suggesting that the subsidence from underground coal mining had little or no negative impact on the riparian plant communities that are supported along the South Fork Quitcupah Creek." (Riparian Plant Community Monitoring in Selected Reaches of South Fork Quitcupah Creek: A Summary (2012-2015), Mt. Nebo Scientific, Inc.)

Sites Q10S and Q11C will continue to be monitored through 2016. They are in the deep canyon area of South Fork. An addendum to the Riparian Vegetation Monitoring Table is included in Appendix 3-14 as are the riparian vegetation monitoring reports for 2012 thru 2015 and the summary report written in 2016.

The applicant will request that future power lines on the SUFACO Mine site be constructed per OSM and UDOGM regulations or with alternative guidelines approved by the regulatory authority. Additional information referencing power lines is located in Section 3.5.8.5.

Efforts will be taken to regulate the use of pesticides when needed. Before a pesticide is used, the type and concentration will be approved by the Regulatory Authority.

### **3.40 Reclamation Plan**

The Reclamation Plan will include the seed mix and rate of seedlings per acre as well as stocking rates for shrub plantings, planting techniques, fertilization methods and amount and frequency of application. The fish (see Section 3.2.2) and wildlife plan for the permit area is outlined in Section 3.4.2.

#### **3.4.1 Revegetation**

The reclamation plan for final revegetation is included in this section for all lands disturbed by coal mining and reclamation operations.



**CHAPTER 5**  
**ENGINEERING**

channel for an extended period of time, the stream will be temporarily diverted using native materials and a pipe to carry the flow over the crack to maintain the channel flow. Arrangements will be made to get a contractor to the site as soon as possible to repair the crack after consultation with the Forest Service.

There may be sections of the stream channel that may require more intensive mitigation efforts to restore surface flows in the creek. These efforts could include the drilling of closely spaced shallow boreholes in and adjacent to the stream channel and the injection of an acceptable impermeable grout into the alluvium or bedrock. The work will be accomplished either using hand tools or low impact equipment to minimize surface disturbance. Existing roads and turnouts will be used as staging areas to locate larger equipment and supplies. Any hoses or lines will be transported from the staging areas to the nearby work sites either by hand, the use of pack animals, or by helicopter. This work will be done with a contractor selected after consultation with the Forest Service.

Additionally, it may be required to remove loose rock from the channel floor, either where the channel flows across thin-bedded bedrock or where large rock have fallen into the channel and is impeding flows. In the instance of the former, past experience has shown this can occur in the upper Blackhawk Formation and is easily repaired by removing enough of the broken channel surface to again expose the stream flow. In the instance of the later, removal of large rocks could be accomplished by drilling and then fracturing the rock into smaller fragments more easily moved to locations where they are not impeding flow. This work may be completed using available pneumatic or hydraulic tools that do not require road or pad building disturbances. In the unlikely event that large boulders do need to be moved, pumps and tanks necessary to complete the work will be located in pre-disturbed areas, such as roads or turnouts, and hoses will be walked into the work area.

A copy of the "Monitoring and Mitigation Plan for Undermining the South Fork of Quitcupah 2R2S Block "A" and 3R2S Block "B" has been included in Appendix 3-14. The preceding paragraphs have been prepared based on this plan. Sufco will attempt to meet all of the monitoring and mitigation responsibilities described in the plan as it pertains to the undermining of the South Fork of Quitcupah 2R2S Block "A" and 3R2S Block "B" Refer to Chapter 3, Section 3.3.3.3 for additional information.



## **CHAPTER 7**

### **HYDROLOGY**

Semi-weekly flow observations and visual inspections will continue for at least 12 weeks, or as conditions allow, after the completion of mining under the stream channel. The bi-weekly (once every two weeks) stream flow monitoring will continue for at least four weeks, or as conditions and monitoring results indicate necessary, after the completion of subsidence mining under the stream channel. The monitoring plan will then change to quarterly flow and field parameter measurements for two years at four sites: one upstream of the panel, one within the panel, and two downstream of the panel. The location of these new temporary monitoring sites are listed in Table 7-2 and shown on Plate 7-3 and labeled as sites 006A, 006B, 006C and 006D. Additional flow monitoring may be needed to determine specific locations where flow is being lost, and treatments are needed.

Mining ceased beneath the South Fork of Quitchupah Creek in March 2015 (Panel 3R2S) and per the mitigation plan the weekly monitoring obligation for the ponds, springs and channel upstream of the culvert road crossing ceased on June 30, 2016. Both a study of the riparian vegetation and flow data (DOGM database) have provided justification for discontinuing the monitoring. The channel, riparian vegetation and springs appear to be stable and unaffected by subsidence associated with underground mining. Ponds 94-1394, 94-982 and 94-115 have shown no effect from mining in the area of the South Fork of Quitchupah and therefore monitoring was discontinued on July 10, 2016. Weekly water monitoring will continue from the culvert road crossing downstream to the confluence of the North and South Fork of Quitchupah Creek, as will the search for and repair of mining-induced subsidence damage.

The subsidence monitoring plan for the South Fork of Quitchupah will include frequent inspection of the stream channel during and after active subsidence. While mining is occurring under the stream channel, and within the 15-degree angle-of-draw above the active longwall face, that area of the channel will be inspected semi-weekly for subsidence cracks or other related features. As the longwall face advances and the 15-degree angle-of-draw area follows, the portions of the channel that now lie outside the 15-degree angle-of-draw will be monitored for subsidence features on a quarterly basis for two years following the cessation of subsidence related effects, if any, due to mining.

Mitigation of cracks that interrupt or divert flows from the stream channel will be sealed immediately with an appropriate impermeable grout or, in some cases, native materials. Sufco will attempt to seal cracks with the least intrusive methods (typically hand placement of grout or native materials) first. The sealing material may be placed by pouring it directly into the crack or, if cracks occur in an actively flowing portion of the stream, the stream may be temporarily diverted using native materials (or a designed flume if necessary to maintain the flow) until the crack is sealed. If cracks are present in channel walls defined by soil, the soil cracks may be hand filled using a native soil/bentonite mix. The sealing of the channel floor and walls will be accomplished with hand tools such as shovel, picks, trowels, etc.

As a backup plan, in the unlikely event that cracks too large to be sealed through the efforts of one or two persons in one day do occur and it appears there is a danger of water being diverted from the channel for an extended period of time, the stream will be temporarily diverted using native materials and a pipe to carry the flow over the crack to maintain the channel flow. Arrangements will be made to get a contractor to the site as soon as possible to repair the crack after consultation with the Forest Service.

There may be sections of the stream channel that may require more intensive mitigation efforts to restore surface flows in the creek. These efforts could include the drilling of closely spaced shallow boreholes in and adjacent to the stream channel and the injection of an acceptable impermeable grout into the alluvium or bedrock. The work will be accomplished either using hand tools or low impact equipment to minimize surface disturbance. Existing roads and turnouts will be used as staging areas to locate larger equipment and supplies. Any hoses or lines will be transported from the staging areas to the nearby work sites either by hand, the use of pack animals, or by helicopter. This work will be done with a contractor selected after consultation with the Forest Service.

Additionally, it may be required to remove loose rock from the channel floor, either where the channel flows across thin-bedded bedrock or where large rock have fallen into the channel and is impeding flows. In the instance of the former, past experience has shown this can occur in the upper Blackhawk Formation and is easily repaired by removing enough of the broken

channel surface to again expose the stream flow. In the instance of the later, removal of large rocks could be accomplished by drilling and then fracturing the rock into smaller fragments more easily moved to locations where they are not impeding flow. This work may be completed using available pneumatic or hydraulic tools that do not require road or pad building disturbances. In the unlikely event that large boulders do need to be moved, pumps and tanks necessary to complete the work will be located in pre-disturbed areas, such as roads or turnouts, and hoses will be walked into the work area.

Sufco will conduct longwall mining operations in such a manner as to minimize surface disturbance while mining within the 15-degree angle-of-draw area that includes the South Fork stream channel. This will be accomplished by advancing the longwall on a schedule where mining will not be suspended for a period to exceed 48 hours.

A copy of the "Monitoring and Mitigation Plan for Undermining the South Fork of Quitcupah 2R2S Block "A" and 3R2S Block "B" has been included in Appendix 3-14. The preceding paragraphs have been prepared based on this plan. Sufco will attempt to meet all of the monitoring and mitigation responsibilities described in the plan as it pertains to the undermining of the South Fork of Quitcupah 2R2S Block "A" and 3R2S Block "B". Refer to Chapter 3, Section 3.3.3.3 for additional information.

A bi-weekly (once every two weeks) report on the impacts to stream flow and required mitigation, if any, will be submitted via e-mail to the Division and the Forest detailing the results of the inspections while mining is occurring under the stream channel. The reports will include, but not necessarily be limited to: a map illustrating the current location of the longwall face; descriptions and dates of field activities; noted changes in stream and local geomorphology; location, width, frequency of cracks; and a description of repairs, if any, conducted. If the prescribed inspections cannot be conducted the reason for the missed inspection and a record of the attempt to conduct the inspection will be submitted to Division and the Forest in the report. Division and the Forest will be notified immediately after mining-induced cracks, if any, are found in the South Fork stream channel and the steps taken or planned to be taken as mitigation. Thereafter, Division and the Forest will be advised of continuing mitigation efforts, if needed, in the report.



**APPENDIX 3-14**

**Monitoring and Mitigation Plan for Undermining  
the South Fork of Quitchupah 2R2S Block "A" and 3R2S Block "B"**

Appendix 3-14

**Riparian Vegetation Monitoring Table (Addendum)**

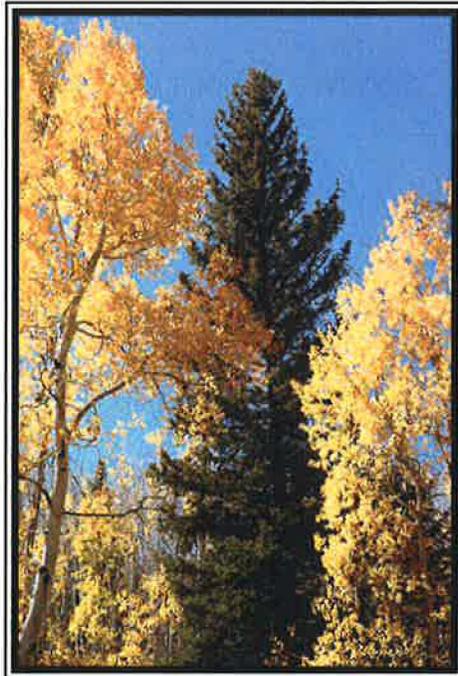
**July 2016**

Panel/Block No.	Sites	Baseline Sampling	DOGM Annual Report	Bi -Annual Study	Final Report
2R2S "A"	Q01C, Q02S, Q03C, Q04S, Q05S, Q06S, Q07C, Q08C, Q09C	2012	2013	2013 - 2015	2016
3R2S "B"	Q010S, Q11C	2013	-	2014 - 2016	2017

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

**August & October  
2012**

**FOR THE  
SUFCO MINE  
SEVIER COUNTY, UTAH**



Aspen & spruce trees at the study area

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Q01C .....	1
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Q04S .....	13
Q05S .....	17
Q06S .....	21
Q07C .....	25
Q08C .....	29
Q09C .....	33

# Introduction

The SUFCO Coal Mine is planning to expand their underground operations near and below some reaches of the South Fork Quitchupah Creek. The riparian plant communities supported along the creek will be monitored for possible impacts that could be caused by mine-related subsidence. These studies will be 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 2012 – August and October.

## 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. Geology of the study area is within the Cretaceous strata of the Mesa Verde Group. The sample sites lie within the Price River Formation below the North Horn Formation. The lowest study site, however, is near the contact zone between the Price River Formation and the cliff-forming Castlegate Sandstone. Elevation of the study area is between 8,200 ft to 8,400 ft above sea level.

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, State of Utah (Division of Water Rights and 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 have.

Qualitative and quantitative data were recorded at the sample stations along South Fork Quitcupah 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 this 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 has 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 topographical features, the intent was to make the transects long enough to cover

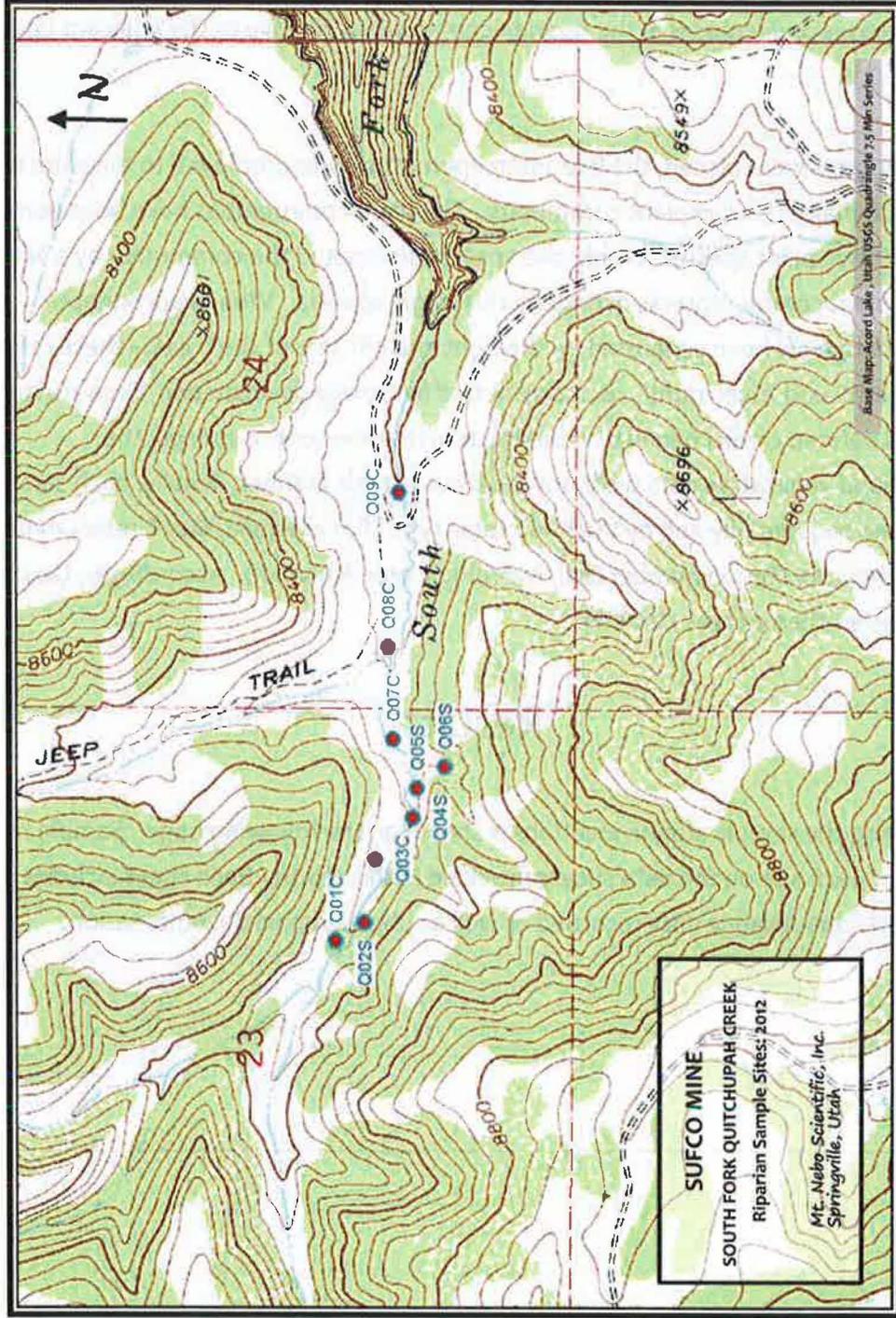
<b>TABLE 1: RIPARIAN COMPLEX DATA SHEET</b>	
CLIENT:	
SAMPLE NUMBER:	
WATERBODY NAME:	
LOCATION:	
DATE:	
OBSERVER(S):	
QUAD NAME:	
GEOLOGIC PARENT MATERIAL:	
STREAM ASPECT:	
STREAM GRADIENT:	
ELEVATION:	
SIZE OF COMPLEX:	
ADJACENT UPLAND VEGETATION (looking downstream)	
Left:	Right:
VEGETATIVE DESCRIPTION (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:	

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 (Quitcupah), 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.

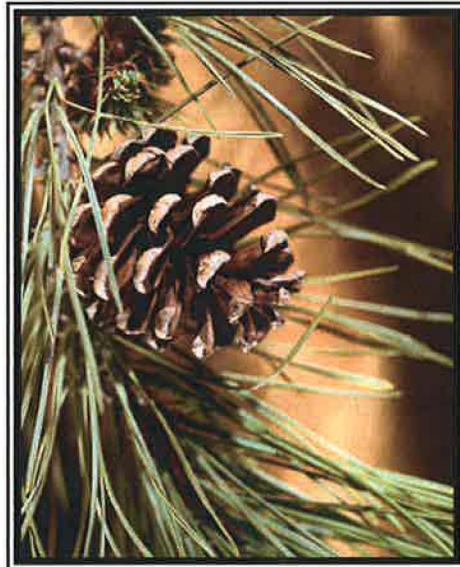


# SECTION 1

## RIPARIAN COMPLEX DATA SHEETS

for the

AUGUST 2012  
SAMPLE PERIOD



RIPARIAN COMPLEX DATA SHEET  
August 2012

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q01C*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *August 8-9, 2012*

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
<i>(refer to quantitative data results for this information)</i>	

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

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *600 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)
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Achillea millefolium</i>	<i>Juncus arcticus</i>
<i>Salix boothii</i>	<i>Rosa woodsii</i>	<i>Taraxacum officinale</i>	<i>Juncus longistylis</i>
	<i>Symphoricarpos oreophilus</i>		<i>Poa pratensis</i>

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: *25 (short Booth's willow)*

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*

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

% bank length with overhanging vegetation: *0*

BANK CONDITION

% bank length vegetated, stable: *85*

% bank length unvegetated, stable: *5*

% bank length vegetated, unstable: *5*

% bank length unvegetated, unstable: *5*

NOTES:

1) *A stream channel sample area.*

2) *This is a good creek channel monitoring site. It is outside the cattle trail and readily monitored.*

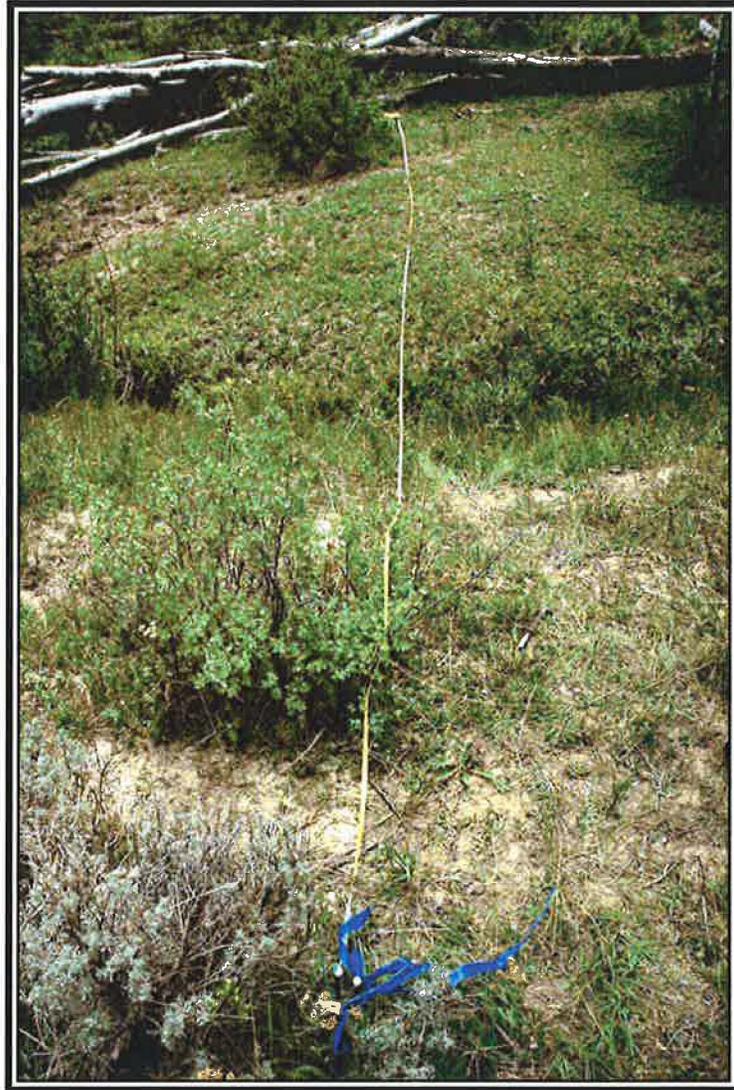
3) *Probably a good "control" site (outside the subsidence zone).*

## DATA SUMMARY

### Q01C: Cover by plant community types in the South Fork Quitchupah Creek drainage (August 2012).

<b>USDA Forest Service Protocol (1992)</b>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Symphoricarpos oreophilus/Artemisia tridentata/Poa pratensis</i>	10.00		
<i>Poa pratensis/Taraxacum officinale</i>		10.00	20.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Salix boothii</i>	0.50		
<u>Dominant Herbaceous Species</u>			
<i>Juncus arcticus/Juncus longistylis</i>	3.00		
<i>Carex nebrascensis/Juncus arcticus</i>		5.00	8.50
<b>TOTAL COVER (Upland Species)</b>			20.00
<b>TOTAL COVER (Riparian Species)</b>			8.50
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			1.50
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>30.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q01C

**RIPARIAN COMPLEX DATA SHEET**  
**August 2012**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q025*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *August 8-9, 2012*

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
<i>(refer to quantitative data results for this information)</i>	

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=slight; 5=extreme): *2*

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)
<i>Picea pungens</i>	<i>Ribes sp.</i>	<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Symphoricarpos oreophilus</i>	<i>Equisetum arvense</i>	<i>Carex nebrascensis</i>
		<i>Ranunculus cymbalaria</i>	<i>Poa pratensis</i>
		<i>Taraxacum officinale</i>	

POOL ATTRIBUTES

% area in pools: *50*  
 % pool area made up of pools > 2' deep: *0*

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

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

BANK CONDITION

% bank length vegetated, stable: *35*  
 % bank length unvegetated, stable: *15*  
 % bank length vegetated, unstable: *30*  
 % bank length unvegetated, unstable: *20*

NOTES:

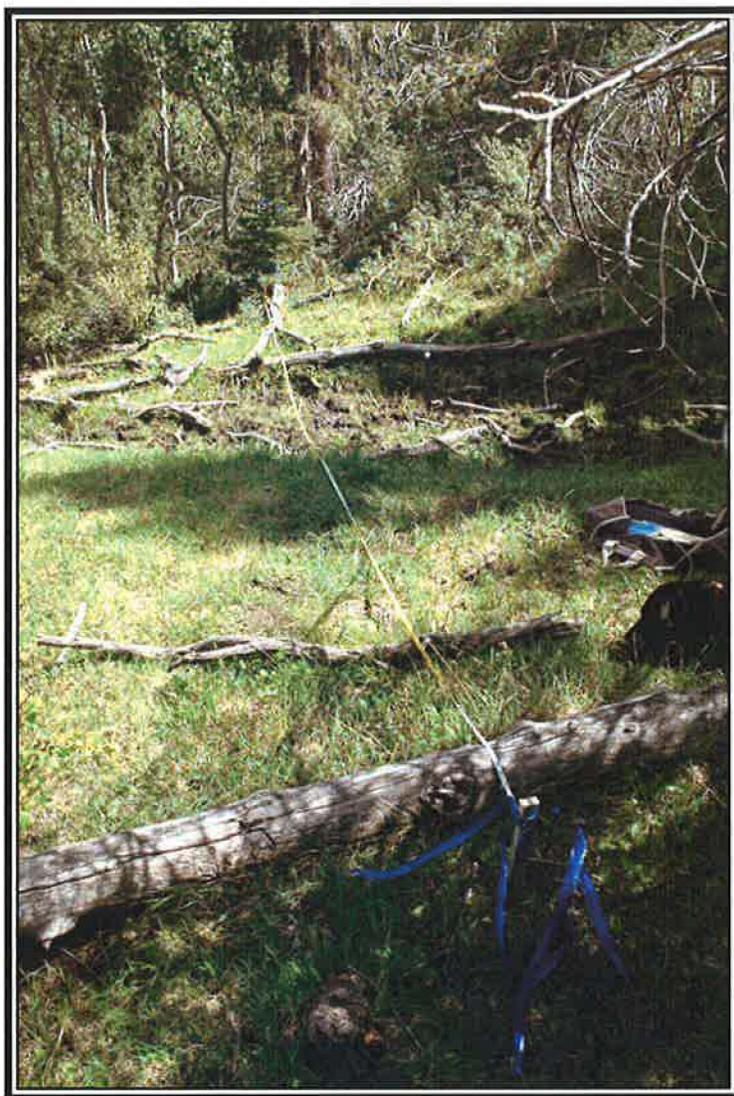
- 1) *This is a spring area.*
- 2) *Cattle hoof-prints were common in the vegetation here thus decreasing the living cover.*
- 3) *Probably a good "control" site (outside the subsidence zone).*

## DATA SUMMARY

**Q02S: Cover by plant community types in the South Fork  
 Quitchupah Creek drainage (August 2012).**

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Poa pratensis</i> / <i>Achillea millefolium</i>	10.00		
<i>Geranium richardsonii</i> / <i>Poa pratensis</i>		10.00	20.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis</i> / <i>Agrostis stolonifera</i> / <i>Ranunculus cymbalaria</i>			13.00
<b>TOTAL COVER (Upland Species)</b>			20.00
<b>TOTAL COVER (Riparian Species)</b>			13.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			0.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>33.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q02S

**RIPARIAN COMPLEX DATA SHEET**  
**August 2012**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q03C*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *August 8-9, 2012*

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
<i>(refer to quantitative data results for this information)</i>	

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

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *850 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 (cattle & wildlife), hunting, recreation.*

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Aster sp.</i>	<i>Agrostis stolonifera</i>
	<i>Rosa woodsii</i>	<i>Equisetum arvense</i>	<i>Juncus arcticus</i>
	<i>Salix boothii</i>	<i>Taraxacum officinale</i>	<i>Juncus longistylis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *50 on rt side; If side vertical*  
 % 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: *5.0*

NOTES:

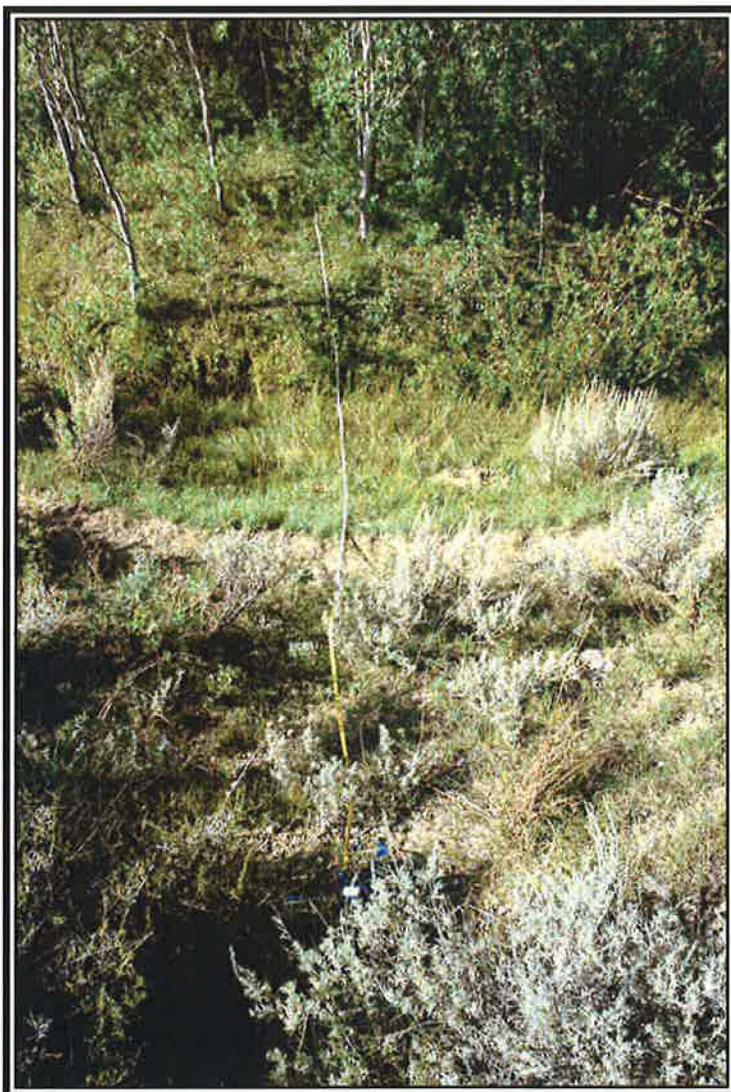
- 1) *This is a channel area.*
- 2) *A good control station; outside current subsidence plans.*
- 3) *It seems like a sample was needed here, but this may be more difficult to monitor as accurately due to the topography. The narrow channel sites are more straight-forward to monitor than this type of area.*
- 4) *Interestingly, the adjacent aspen understory (that was 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.*

## DATA SUMMARY

### Q03C: Cover by plant community types in the South Fork Quitchupah Creek drainage (August 2012).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Artemisia tridentata/Elymus salinus</i>	10.00		
<i>Populus tremuloides/Juncus arcticus</i>		10.00	
			20.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Juncus arcticus</i>	8.00		
<i>Juncus arcticus/Equisetum arvense</i>		7.00	
			15.00
<b>TOTAL COVER (Upland Species)</b>			20.00
<b>TOTAL COVER (Riparian Species)</b>			15.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			2.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>37.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q03C

**RIPARIAN COMPLEX DATA SHEET**  
**August 2012**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q045*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *August 8-9, 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 (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
<i>(refer to quantitative data results for this information)</i>	

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=slight; 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)
<i>Picea pungens</i>	<i>Rosa woodsii</i>	<i>Achillea millefolium</i>	<i>Eleocharis palustris</i>
<i>Populus tremuloides</i>	<i>Salix boothii</i>	<i>Equisetum arvense</i>	<i>Hordeum jubatum</i>
		<i>Geranium richardsonii</i>	<i>Juncus arcticus</i>
			<i>Juncus longistylis</i>
			<i>Poa pratensis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°):  
 % bank length gently sloping (>135°): *100*  
 % bank length with overhanging vegetation: *50*

BANK CONDITION

% bank length vegetated, stable: *70*  
 % bank length unvegetated, stable: *0*  
 % bank length vegetated, unstable: *20*  
 % bank length unvegetated, unstable: *10*

NOTES:

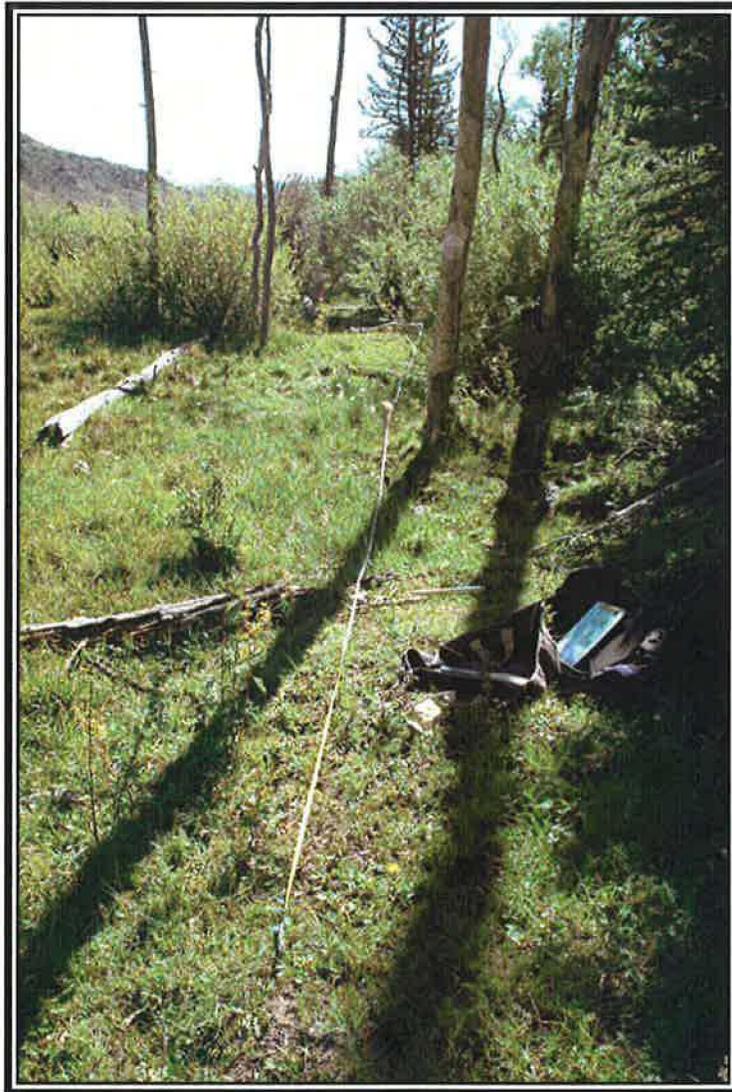
- 1) *This is a spring area.*
- 2) *A good control station; outside current subsidence plans.*
- 3) *This spring has a narrow band of water at this sample period, but it is obviously influenced by more water other times as suggested by the lateral extent of the riparian/wetland vegetation and wet soils.*
- 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 with a width of 14 ft.*
- 6) *There was a lot of impact from cattle trampling here.*

## DATA SUMMARY

### **Q04S: Cover by plant community types in the South Fork Quitchupah Creek drainage (August 2012).**

<b>USDA Forest Service Protocol (1992)</b>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Symphoricarpos oreophilus/Populus tremuloides</i>	10.00		
<i>Picea pungens/Salix boothii</i>		10.00	
			20.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis/Hordeum jubatum</i>			7.00
<i>Eleocharis palustris/Ranunculus cymbalaria</i>			8.00
<i>Eleocharis palustris/Agrostis stolonifera</i>			11.00
<b>TOTAL COVER (Upland Species)</b>			20.00
<b>TOTAL COVER (Riparian Species)</b>			26.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			0.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>46.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q04S

**RIPARIAN COMPLEX DATA SHEET**  
**August 2012**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q055*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *August 8-9, 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 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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Late*

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *800 lbs/acre*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=slight; 5=extreme): *3 (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)
<i>Picea pungens</i>	<i>Salix boothii</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
<i>Pinus flexilis</i>	<i>Symphoricarpos oreophilus</i>	<i>Geranium richardsonii</i>	<i>Carex nebrascensis</i>
<i>Populus tremuloides</i>		<i>Ranunculus cymbalaria</i>	

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*  
 % bank length gently sloping (>135°): *100*  
 % bank length with overhanging vegetation: *20*

BANK CONDITION

% bank length vegetated, stable: *60*  
 % bank length unvegetated, stable: *0*  
 % bank length vegetated, unstable: *20 (cattle impacts)*  
 % bank length unvegetated, unstable: *20*

NOTES:

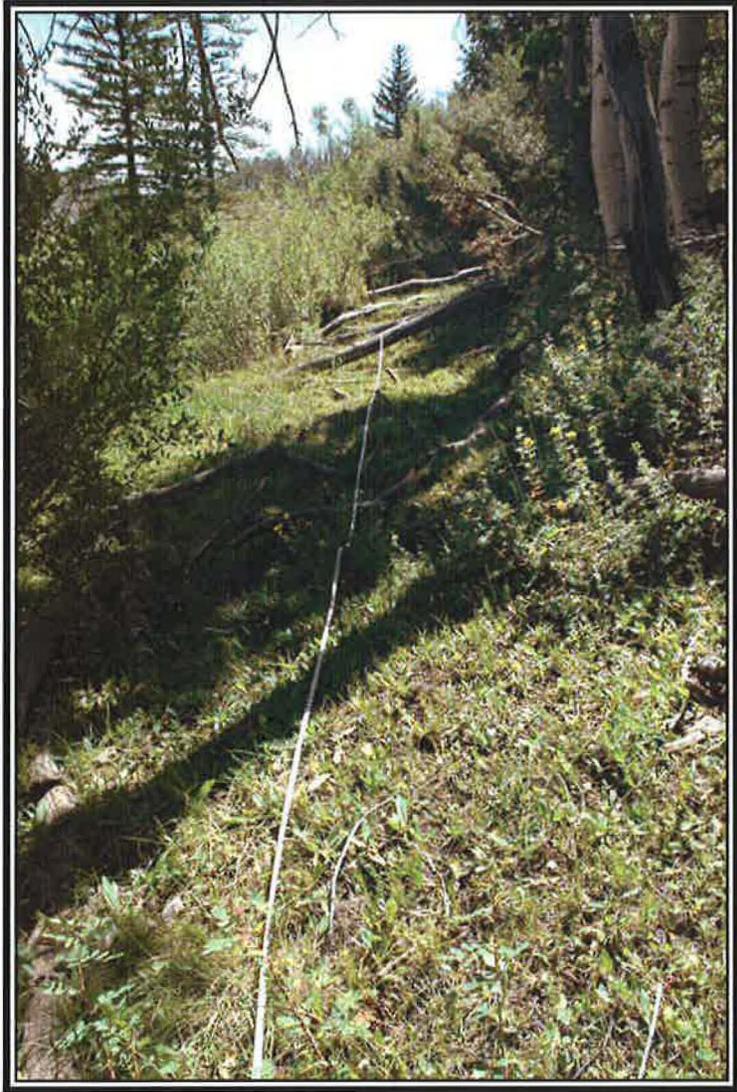
- 1) *This is a well-defined spring area.*
- 2) *A good control station; it is just outside current subsidence plans.*
- 3) *When the transect tape was placed, it formed a "U" shape to measure. This tape was placed 4 ft from the upland bank for 73 ft of riparian/spring vegetation.*
- 4) *About 50% of the transect tape length had water present, the remainder was wet and muddy.*
- 5) *There was a lot of impact from cattle trampling here.*

## DATA SUMMARY

### Q05S: Cover by plant community types in the South Fork Quitchupah Creek drainage (August 2012).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Salix boothii/Picea pungens</i>	10.00		
<i>Picea pungens/Populus tremuloides</i>		10.00	20.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis/Agrostis stolonifera/Ranunculus cymbalaria</i>			73.00
<b>TOTAL COVER (Upland Species)</b>			20.00
<b>TOTAL COVER (Riparian Species)</b>			73.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			0.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>93.00</b>

PHOTOGRAPHIC DOCUMENTATION



Q05S

**RIPARIAN COMPLEX DATA SHEET**  
**August 2012**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q065*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *August 8-9, 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 (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
<i>(refer to quantitative data results for this information)</i>	

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=slight; 5=extreme): *3 (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)
<i>Populus tremuloides</i>	<i>Ribes sp</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
	<i>Salix boothii</i>	<i>Taraxacum officinale</i>	<i>Poa pratensis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*  
 % bank length gently sloping (>135°): *100*  
 % bank length with overhanging vegetation: *25*

BANK CONDITION

% bank length vegetated, stable: *25*  
 % bank length unvegetated, stable: *0*  
 % bank length vegetated, unstable: *30 (cattle impacts)*  
 % bank length unvegetated, unstable: *45*

NOTES:

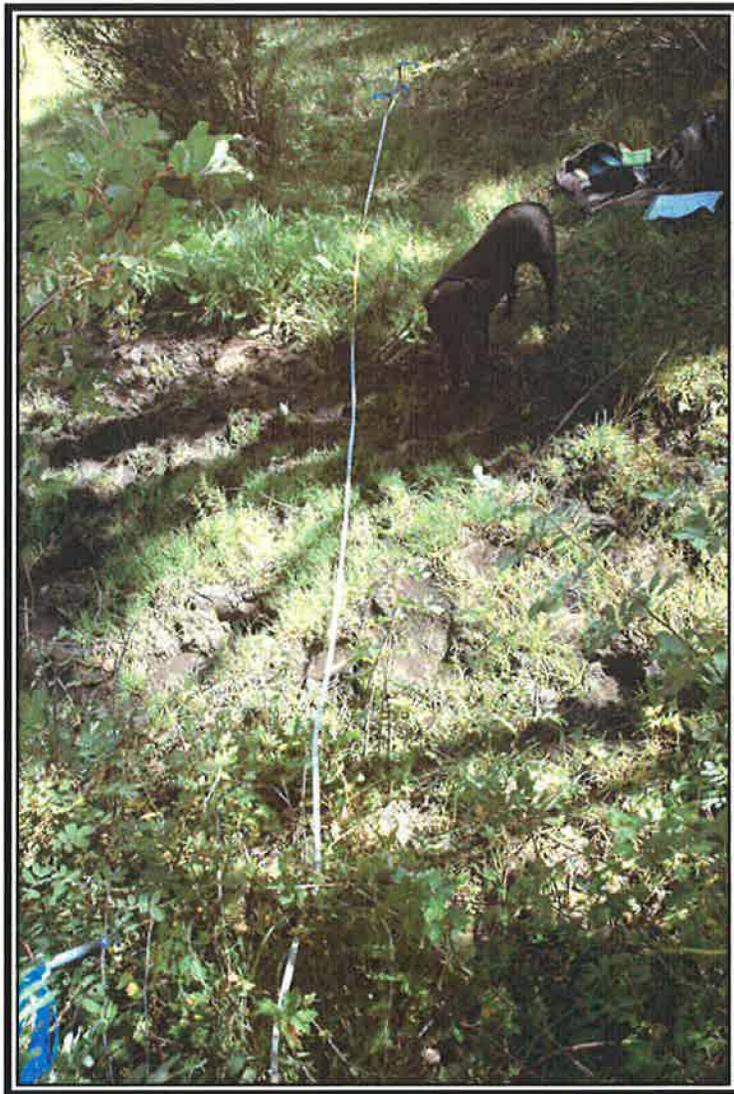
- 1) *Only measured obvious, well-defined spring area*
- 2) *Left side measured to bank (3 ft)*
- 3) *Sample station was located within current planned subsidence zone*

## DATA SUMMARY

### Q06S: Cover by plant community types in the South Fork Quitchupah Creek drainage (August 2012).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Populus tremuloides/Salix boothii</i>	3.00		
<i>Symphoricarpos oreophilus/Grasses</i>		9.00	
			12.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Agrostis stolonifera</i>			8.00
<b>TOTAL COVER (Upland Species)</b>			12.00
<b>TOTAL COVER (Riparian Species)</b>			8.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			0.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>20.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q06S

**RIPARIAN COMPLEX DATA SHEET**  
**August 2012**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q07C*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *August 8-9, 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
<i>(refer to quantitative data results for this information)</i>	

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=slight; 5=extreme): *7*

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)
	<i>Rosa woodsii</i>		<i>Agrostis stolonifera</i>
	<i>Salix boothii</i>		<i>Carex nebrascensis</i>
			<i>Hordeum jubatum</i>
			<i>Poa pratensis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *50 (rt 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: *7*  
 % bank length vegetated, unstable: *2*  
 % bank length unvegetated, unstable: *2*

NOTES:

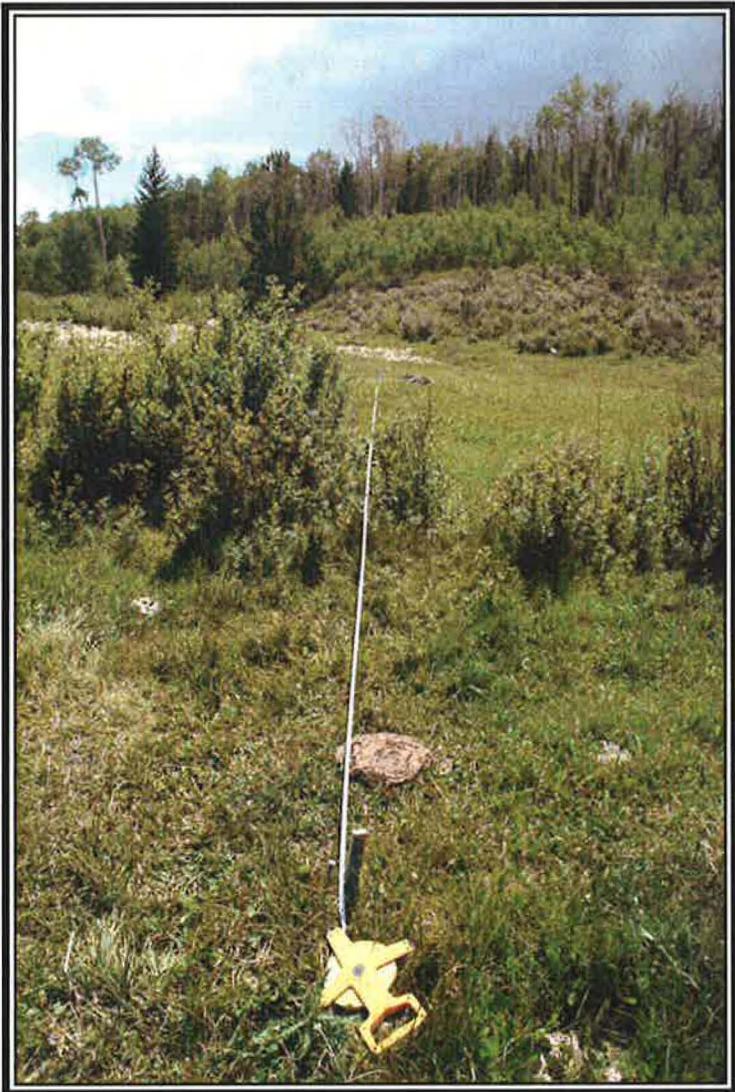
- 1) *This site is in the middle of a meadow.*
- 2) *Right side: the upland area was obvious as seen by upland vegetation. It was mostly dominated by Poa pratensis (although this is now considered a facultative wetland species). On this side the riparian community was measured where Carex nebrascensis began.*
- 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. In this meadow there were patches that were dominated by Hordeum jubatum.*
- 4) *This site is within the current planned subsidence zone.*

## DATA SUMMARY

### **Q07C: Cover by plant community types in the South Fork Quitchupah Creek drainage (August 2012).**

<b>USDA Forest Service Protocol (1992)</b>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>	10.00		
<i>Poa pratensis/Achillea millefolium</i>		10.00	
<i>Poa pratensis/Achillea millefolium</i>			20.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Rosa woodsii</i>	7.00		
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis</i>	8.00	10.50	
<i>Carex nebrascensis/Hordeum jubatum</i>	8.00		
			33.50
<b>TOTAL COVER (Upland Species)</b>			20.00
<b>TOTAL COVER (Riparian Species)</b>			33.50
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			1.50
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>55.00</b>

PHOTOGRAPHIC DOCUMENTATION



Q07C

**RIPARIAN COMPLEX DATA SHEET**

**August 2012**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q08C*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *August 8-9, 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
<i>(refer to quantitative data results for this information)</i>	

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=slight; 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)
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Trifolium sp.</i>	<i>Agrostis stolonifera</i>
	<i>Salix boothii</i>		<i>Carex nebrascensis</i>
			<i>Juncus arcticus</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*  
 % bank length gently sloping (>135°): *100 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: *7*  
 % bank length vegetated, unstable: *0*  
 % bank length unvegetated, unstable: *4*

NOTES:

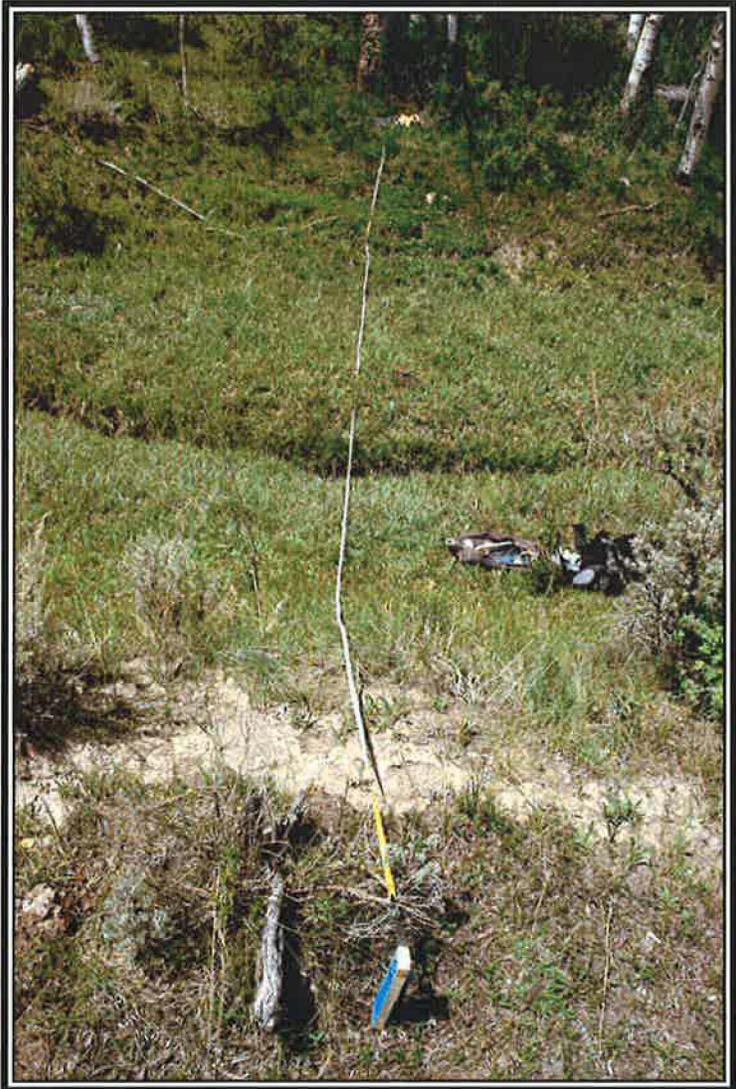
- 1) *This site had a straightforward area to monitor the riparian zone. The station went from low water to a low terrace, then a high terrace and finally to the aspen forest.*
- 2) *This site is within the current planned subsidence zone.*

## DATA SUMMARY

### Q08C: Cover by plant community types in the South Fork Quitchupah Creek drainage (August 2012).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Artemisia tridentata/Grasses</i>	10.00		
<i>Populus tremuloides/Symphoricarpos oreophilus</i>		10.00	
			20.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Rosa woodsii</i>			
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis</i>	6.00	15.00	
<i>Juncus arcticus</i>	2.00		
			23.00
<b>TOTAL COVER (Upland Species)</b>			20.00
<b>TOTAL COVER (Riparian Species)</b>			23.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			1.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>44.00</b>

PHOTOGRAPHIC DOCUMENTATION



Q08C

**RIPARIAN COMPLEX DATA SHEET**  
*August 2012*

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q09C*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *August 8-9, 2012*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Mid-*

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): *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)
	<i>Artemisia tridentata</i>	<i>Trifolium sp.</i>	<i>Agrostis stolonifera</i>
	<i>Rosa woodsii</i>		<i>Juncus arcticus</i>
	<i>Salix boothii</i>		<i>Poa pratensis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *100 on both sides of the channel.*  
 % bank length gently sloping (>135°): *100 but above the incised (24") channel.*  
 % bank length with overhanging vegetation: *Herbaceous*

BANK CONDITION

% bank length vegetated, stable: *90*  
 % bank length unvegetated, stable: *0*  
 % bank length vegetated, unstable: *2*  
 % bank length unvegetated, unstable: *3*

NOTES:

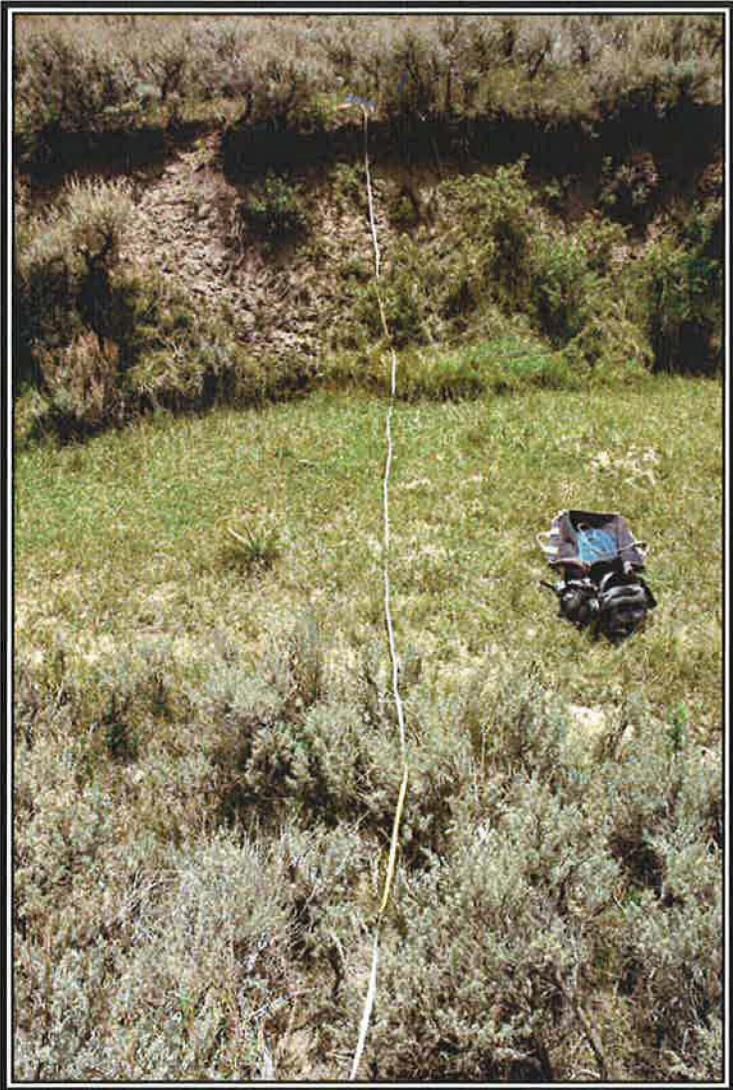
- 1) *This site had a straightforward area to monitor the riparian zone.*
- 2) *This site is within the current planned subsidence zone.*

## DATA SUMMARY

### Q09C: Cover by plant community types in the South Fork Quitchupah Creek drainage (August 2012).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>	9.00		
<i>Artemisia tridentata/Grasses</i>		10.00	
<i>Artemisia tridentata/Grasses</i>			19.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis/Agrostis stolonifera/Ranunculus cymbalaria</i>	13.00		
<i>Agrostis stolonifera</i>		2.00	
			15.00
<b>TOTAL COVER (Upland Species)</b>			19.00
<b>TOTAL COVER (Riparian Species)</b>			15.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			2.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>36.00</b>

PHOTOGRAPHIC DOCUMENTATION



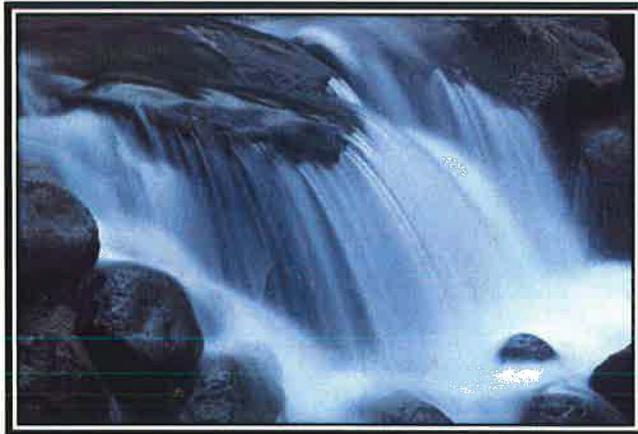
Q09C

# SECTION 2

## RIPARIAN COMPLEX DATA SHEETS

for the

OCTOBER 2012  
SAMPLE PERIOD



**RIPARIAN COMPLEX DATA SHEET**  
**October 2012**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q01C*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 2, 2012*

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
<i>(refer to quantitative data results for this information)</i>	

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

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *600 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)
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Achillea millefolium</i>	<i>Juncus arcticus</i>
<i>Salix boothii</i>	<i>Rosa woodsii</i>	<i>Taraxacum officinale</i>	<i>Poa pratensis</i>
	<i>Symphoricarpos oreophilus</i>		

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 (<90°): *0*  
 % bank length gently sloping (>135°): *0*  
 % bank length with overhanging vegetation: *25 (short Booth's willows)*

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) *A stream channel sample area.*
- 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).*

## DATA SUMMARY

### Q01C: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2012).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Symphoricarpos oreophilus/Artemisia tridentata/Poa pratensis</i>	10.00		
<i>Poa pratensis/Taraxacum officinale</i>		10.00	20.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Salix boothii</i>	0.50		
<u>Dominant Herbaceous Species</u>			
<i>Juncus arcticus</i>	3.00		
<i>Carex nebrascensis/Agrostis stolonifera/Ranunculus cymbalaria</i>		5.00	8.50
<b>TOTAL COVER (Upland Species)</b>			20.00
<b>TOTAL COVER (Riparian Species)</b>			8.50
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			1.50
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>30.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q01C

**RIPARIAN COMPLEX DATA SHEET**  
**October 2012**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q025*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 2, 2012*

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
<i>(refer to quantitative data results for this information)</i>	

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=slight; 5=extreme): *2*

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)
<i>Picea pungens</i>	<i>Ribes sp.</i>	<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Symphoricarpos oreophilus</i>	<i>Equisetum arvense</i>	<i>Carex nebrascensis</i>
		<i>Ranunculus cymbalaria</i>	<i>Poa pratensis</i>
		<i>Taraxacum officinale</i>	

POOL ATTRIBUTES

% area in pools: *100*

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

AQUATIC VEGETATION

% streambed with filamentous algae: *0*

% stream margin with rooted aquatic: *0*

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*

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

% bank length with overhanging vegetation: *0*

BANK CONDITION

% bank length vegetated, stable: *35*

% bank length unvegetated, stable: *15*

% bank length vegetated, unstable: *30*

% bank length unvegetated, unstable: *20*

NOTES:

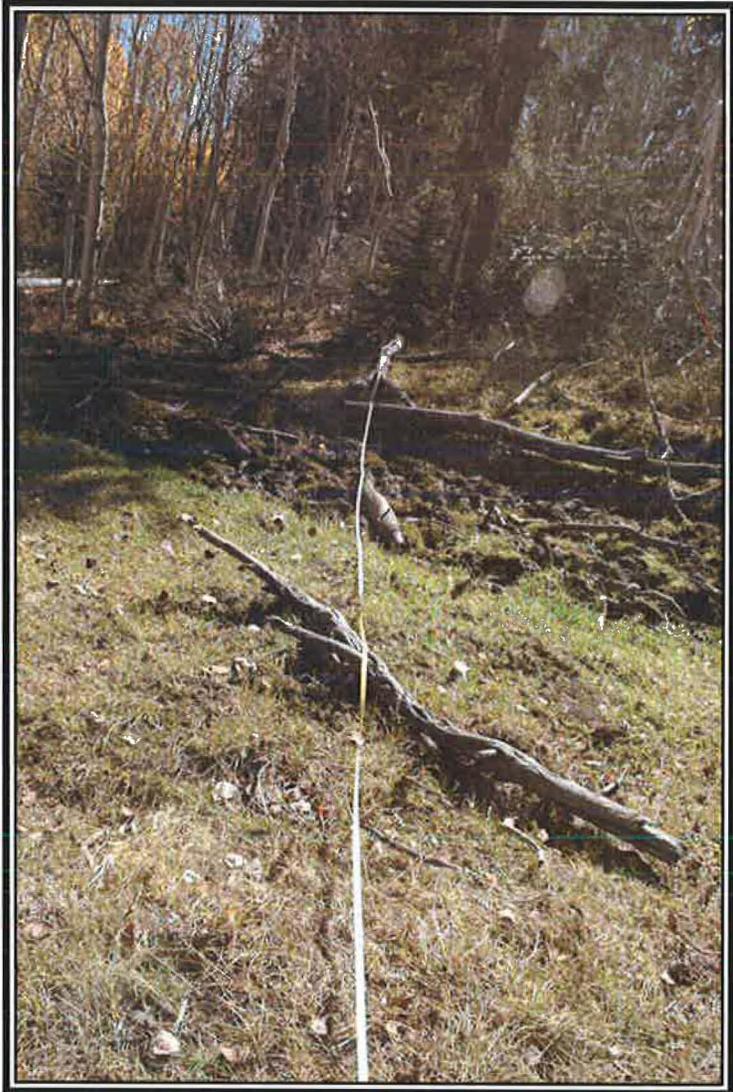
- 1) *This is a spring area.*
- 2) *Probably a good "control" site (outside the subsidence zone).*
- 3) *Cattle hoof-prints were common in the vegetation here thus decreasing the living cover.*
- 4) *The Bank Condition represents both the bank and wet areas (refer to the photograph).*
- 5) *Most of the riparian vegetation had water surrounding it, or 9.0 ft out of 13.5 ft.*

## DATA SUMMARY

### Q02S: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2012).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Poa pratensis</i> / <i>Achillea millefolium</i>	9.50		
<i>Geranium richardsonii</i> / <i>Poa pratensis</i>		10.00	
			19.50
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Ranunculus cymbalaria</i> / <i>Agrostis stolonifera</i>			
<i>Carex nebrascensis</i> / <i>Agrostis stolonifera</i> / <i>Ranunculus cymbalaria</i>			13.50
<b>TOTAL COVER (Upland Species)</b>			19.50
<b>TOTAL COVER (Riparian Species)</b>			13.50
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			0.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>33.00</b>

PHOTOGRAPHIC DOCUMENTATION



Q02S

**RIPARIAN COMPLEX DATA SHEET**  
**October 2012**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q03C*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 2, 2012*

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
<i>(refer to quantitative data results for this information)</i>	

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

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *850 lbs/acre*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=slight; 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)
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Aster sp.</i>	<i>Agrostis stolonifera</i>
	<i>Rosa woodsii</i>	<i>Equisetum arvense</i>	<i>Juncus arcticus</i>
	<i>Salix spp.</i>	<i>Taraxacum officinale</i>	<i>Juncus longistylis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *50 on rt side; lf side vertical*  
 % 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:

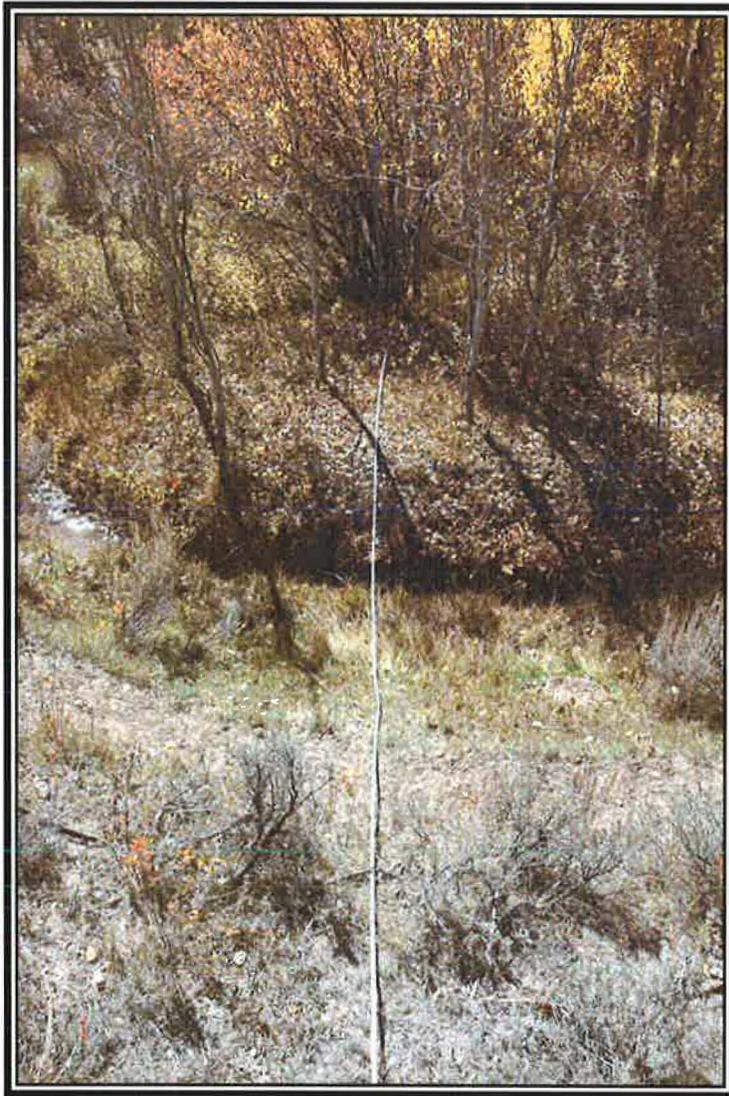
- 1) *This is a channel area.*
- 2) *A good control station; outside current subsidence plans.*
- 3) *It seems like we needed a sample here, but this may be more difficult to monitor as accurately due to the topography. The narrow channel sites are more straight-forward to monitor than this type.*
- 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.*

## DATA SUMMARY

### Q03C: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2012).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Artemisia tridentata/Elymus salinus</i>	9.50		
<i>Populus tremuloides/Juncus arcticus</i>		10.00	
			19.50
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Juncus arcticus/Poa pratensis</i>	4.50	3.50	
<i>Juncus arcticus</i>		6.00	
			14.00
<b>TOTAL COVER (Upland Species)</b>			19.50
<b>TOTAL COVER (Riparian Species)</b>			14.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			1.50
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>35.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q03C

**RIPARIAN COMPLEX DATA SHEET**  
**October 2012**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q045*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 2, 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 (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
<i>(refer to quantitative data results for this information)</i>	

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=slight; 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)
<i>Picea pungens</i>	<i>Rosa woodsii</i>	<i>Achillea millefolium</i>	<i>Eleocharis palustris</i>
<i>Populus tremuloides</i>	<i>Salix boothii</i>	<i>Equisetum arvense</i>	<i>Hordeum jubatum</i>
		<i>Geranium richardsonii</i>	<i>Juncus arcticus</i>
			<i>Juncus longistylis</i>
			<i>Poa pratensis</i>

POOL ATTRIBUTES

% area in pools: *100*

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

AQUATIC VEGETATION

% streambed with filamentous algae: *0*

% stream margin with rooted aquatic: *0*

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°):

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

% bank length with overhanging vegetation: *50*

BANK CONDITION

% bank length vegetated, stable: *40*

% bank length unvegetated, stable: *0*

% bank length vegetated, unstable: *20*

% bank length unvegetated, unstable: *40*

NOTES:

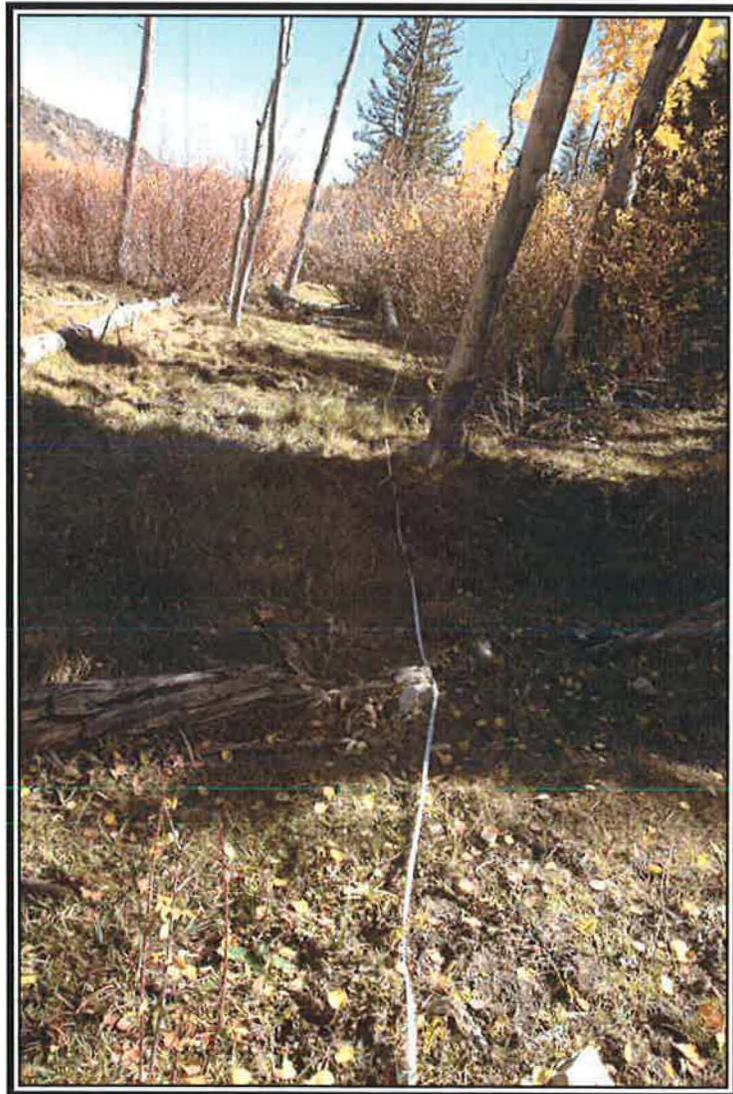
- 1) *This is a spring area.*
- 2) *A good control station; outside current subsidence plans.*
- 3) *The riparian/wetland areas appeared to have more water for this sample period when compared to August 2012. The notes in the August report suggested it may vary.*
- 4) *The spring site had several zones 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 (e.g. 90%), whereas other areas were low (e.g. 30%), so a 60% value was given above.*
- 7) *Not quite sure why August total was 46 ft; there was more upland and riparian vegetation this sample period (check and make appropriate adjustments next visit).*

## DATA SUMMARY

### Q04S: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2012).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Symphoricarpos oreophilus/Populus tremuloides</i>	10.00		
<i>Picea pungens/Salix boothii</i>		16.00	
			26.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis/Hordeum jubatum</i>			10.00
<i>Eleocharis palustris/Ranunculus cymbalaria</i>			15.00
<i>Carex nebrascensis</i>			5.00
<b>TOTAL COVER (Upland Species)</b>			26.00
<b>TOTAL COVER (Riparian Species)</b>			30.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			0.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>56.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q04S

**RIPARIAN COMPLEX DATA SHEET**  
**October 2012**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q055*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 2, 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 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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Late*

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *800 lbs/acre*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=slight; 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)
<i>Picea pungens</i>	<i>Salix boothii</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
<i>Pinus flexilis</i>	<i>Symphoricarpos oreophilus</i>	<i>Geranium richardsonii</i>	<i>Carex nebrascensis</i>
<i>Populus tremuloides</i>		<i>Ranunculus cymbalaria</i>	

POOL ATTRIBUTES

% area in pools: *100*

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

AQUATIC VEGETATION

% streambed with filamentous algae: *0*

% stream margin with rooted aquatic: *0*

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*

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

% bank length with overhanging vegetation: *20*

BANK CONDITION

% bank length vegetated, stable: *60*

% bank length unvegetated, stable: *0*

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

% bank length unvegetated, unstable: *20*

NOTES:

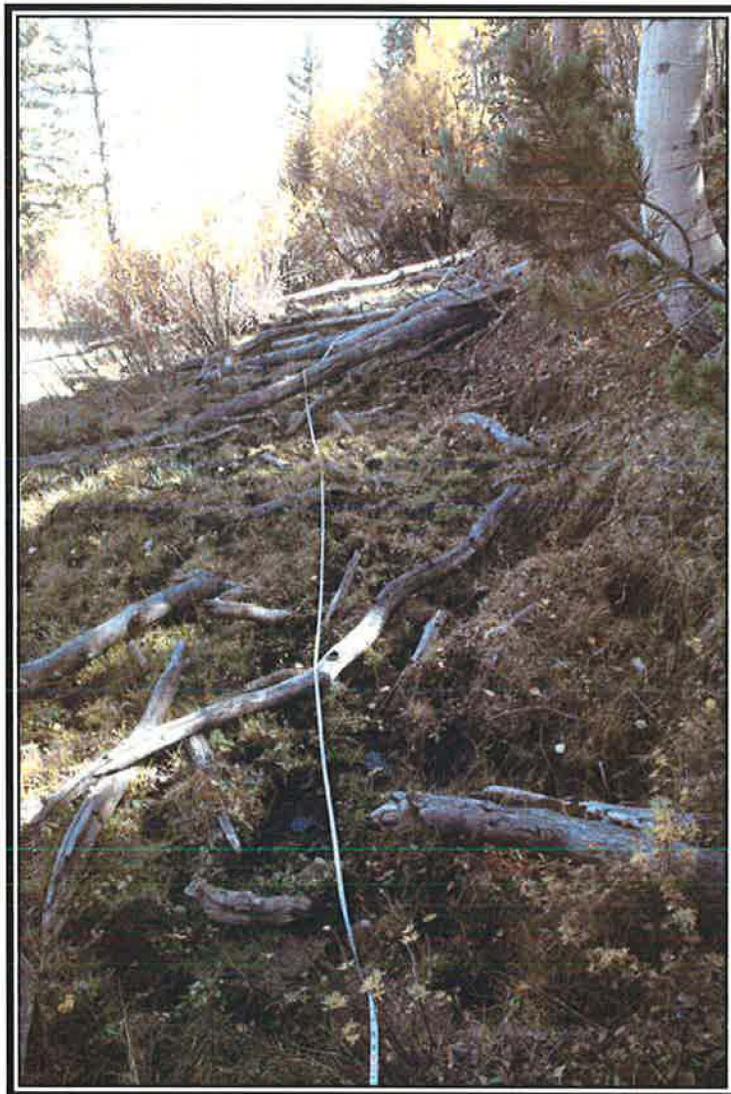
- 1) *This is a well-defined spring area.*
- 2) *A good control station; it is just outside current subsidence plans.*
- 3) *When I used placed the transect tape, it formed a "U" shape to measure. This tape was placed 4 ft from the upland bank for 73 ft of riparian/spring vegetation.*
- 4) *For this sample period, the water area comprised the entire 38 ft out of the 73 ft mentioned above.*
- 5) *There was a lot of impact from cattle trampling at the site.*

## DATA SUMMARY

### Q05S: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2012).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Salix boothii/Picea pungens</i>	10.00		
<i>Picea pungens/Populus tremuloides</i>		10.00	
			20.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis/Agrostis stolonifera/Ranunculus cymbalaria</i>			73.00
<b>TOTAL COVER (Upland Species)</b>			20.00
<b>TOTAL COVER (Riparian Species)</b>			73.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			0.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>93.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q05S

**RIPARIAN COMPLEX DATA SHEET**  
**October 2012**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q065*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 2, 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 (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
<i>(refer to quantitative data results for this information)</i>	

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=slight; 5=extreme): *3 (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)
<i>Populus tremuloides</i>	<i>Ribes sp</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
	<i>Salix boothii</i>	<i>Taraxacum officinale</i>	<i>Poa pratensis</i>

POOL ATTRIBUTES

% area in pools: *100*

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

AQUATIC VEGETATION

% streambed with filamentous algae: *0*

% stream margin with rooted aquatic: *0*

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*

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

% bank length with overhanging vegetation: *25*

BANK CONDITION

% bank length vegetated, stable: *10*

% bank length unvegetated, stable: *0*

% bank length vegetated, unstable: *10*

% bank length unvegetated, unstable: *80 (cattle impact)*

NOTES:

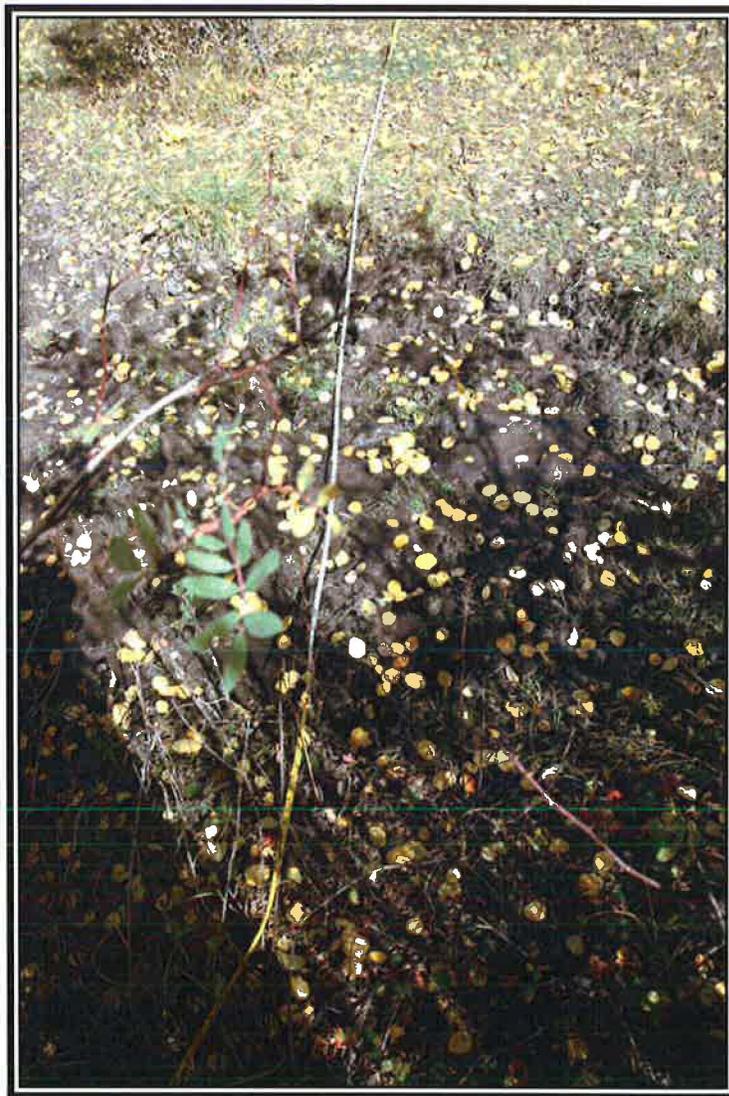
- 1) *Only measured obvious, well-defined spring area.*
- 2) *Left side measured to bank (3 ft).*
- 3) *Cattle had a greater impact this sample period compared to the earlier period this year.*
- 4) *Riparian/wetland vegetation was measured in the spring channel only.*
- 5) *There was 8 ft of this vegetation in the water/hoopprint area.*
- 6) *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 2012).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Populus tremuloides/Salix boothii</i>	3.00		
<i>Symphoricarpos oreophilus/Grasses</i>		9.00	12.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Agrostis stolonifera</i>			8.00
<b>TOTAL COVER (Upland Species)</b>			12.00
<b>TOTAL COVER (Riparian Species)</b>			8.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			0.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>20.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q06S

**RIPARIAN COMPLEX DATA SHEET**  
**October 2012**

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
<i>(refer to quantitative data results for this information)</i>	

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=slight; 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)
	<i>Rosa woodsii</i>		<i>Agrostis stolonifera</i>
	<i>Salix boothii</i>		<i>Carex nebrascensis</i>
			<i>Hordeum jubatum</i>
			<i>Poa pratensis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): *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: *7*
- % bank length vegetated, unstable: *2*
- % bank length unvegetated, unstable: *2*

NOTES:

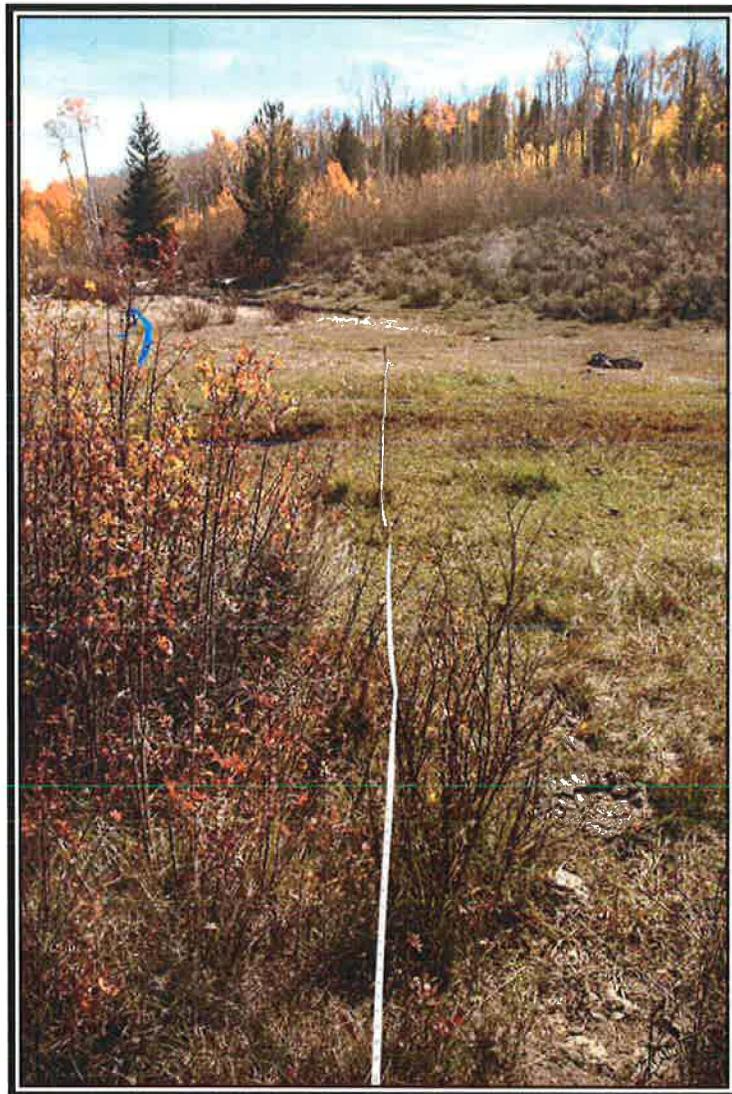
- 1) *This site is in the middle of a meadow.*
- 2) *Right side: the upland area was obvious as seen by upland vegetation. It was mostly dominated by Poa pratensis (although this is now considered a facultative wetland species). On this side the riparian community was measured where Carex nebrascensis began.*
- 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. In this meadow there were patches that were dominated by Hordeum jubatum.*
- 4) *This site is within the current planned subsidence zone.*

## DATA SUMMARY

### Q07C: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2012).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>	10.00		
<i>Poa pratensis/Achillea millefolium</i>		10.00	
<i>Poa pratensis/Achillea millefolium</i>			20.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Rosa woodsii</i>	7.00		
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis</i>	8.00	10.50	
<i>Carex nebrascensis/Hordeum jubatum</i>	8.00		
			33.50
<b>TOTAL COVER (Upland Species)</b>			20.00
<b>TOTAL COVER (Riparian Species)</b>			33.50
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			1.50
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>55.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q07C

**RIPARIAN COMPLEX DATA SHEET**  
**October 2012**

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
<i>(refer to quantitative data results for this information)</i>	

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=slight; 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)
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Trifolium sp.</i>	<i>Agrostis stolonifera</i>
	<i>Salix boothii</i>		<i>Carex nebrascensis</i>
			<i>Juncus arcticus</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*  
 % bank length gently sloping (>135°): *100 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: *7*  
 % bank length vegetated, unstable: *0*  
 % bank length unvegetated, unstable: *4*

NOTES:

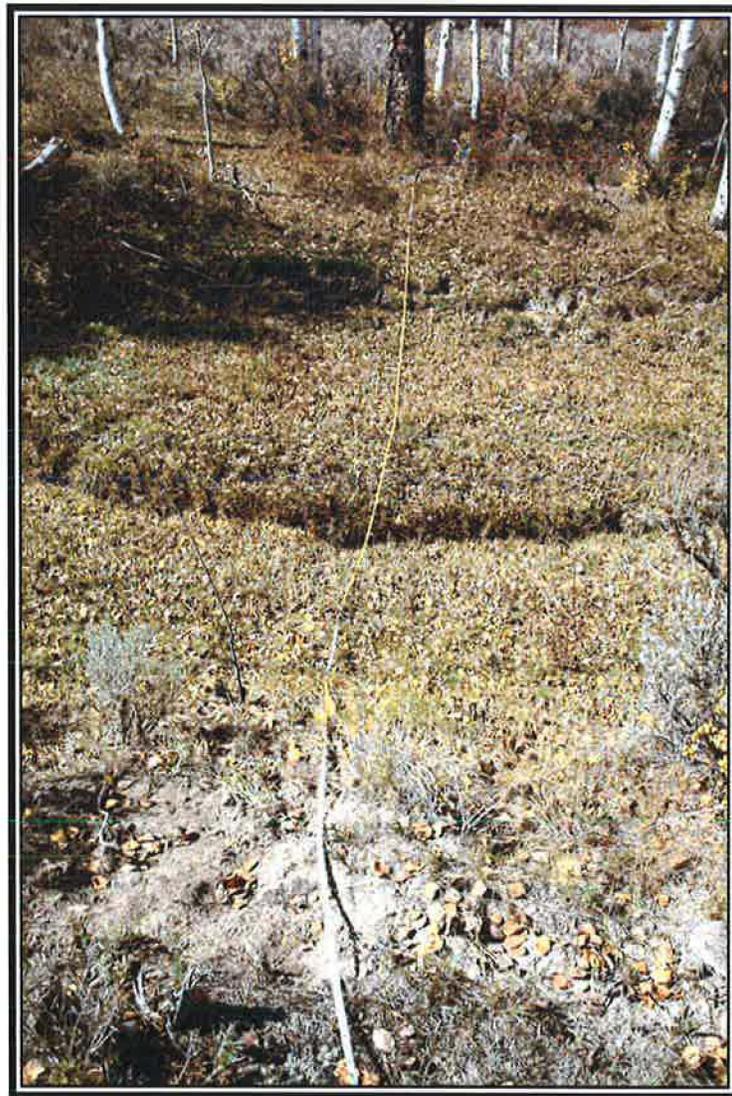
- 1) *This site had a straightforward area to monitor the riparian zone. The station went from low water to a low terrace, then a high terrace and finally to the aspen forest.*
- 2) *This site is within the current planned subsidence zone.*

## DATA SUMMARY

### Q08C: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2012).

<b>USDA Forest Service Protocol (1992)</b>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Artemisia tridentata/Grasses</i>	10.00		
<i>Populus tremuloides/Symphoricarpos oreophilus</i>		10.00	
			20.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Rosa woodsii</i>			
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis</i>	3.00	15.00	
<i>Carex nebrascensis/Agrostis stolonifera/Ranunculus cymbalaria</i>	5.00		
			23.00
<b>TOTAL COVER (Upland Species)</b>			20.00
<b>TOTAL COVER (Riparian Species)</b>			23.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			1.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			44.00

## PHOTOGRAPHIC DOCUMENTATION



Q08C

RIPARIAN COMPLEX DATA SHEET  
October 2012

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q09C*

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: *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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Mid-*

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): *7*

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)
	<i>Artemisia tridentata</i>	<i>Trifolium sp.</i>	<i>Agrostis stolonifera</i>
	<i>Rosa woodsii</i>		<i>Juncus arcticus</i>
	<i>Salix boothii</i>		<i>Poa pratensis</i>

POOL ATTRIBUTES

% area in pools: *0*

% pool area made up of pools > 2' deep: *25*

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:

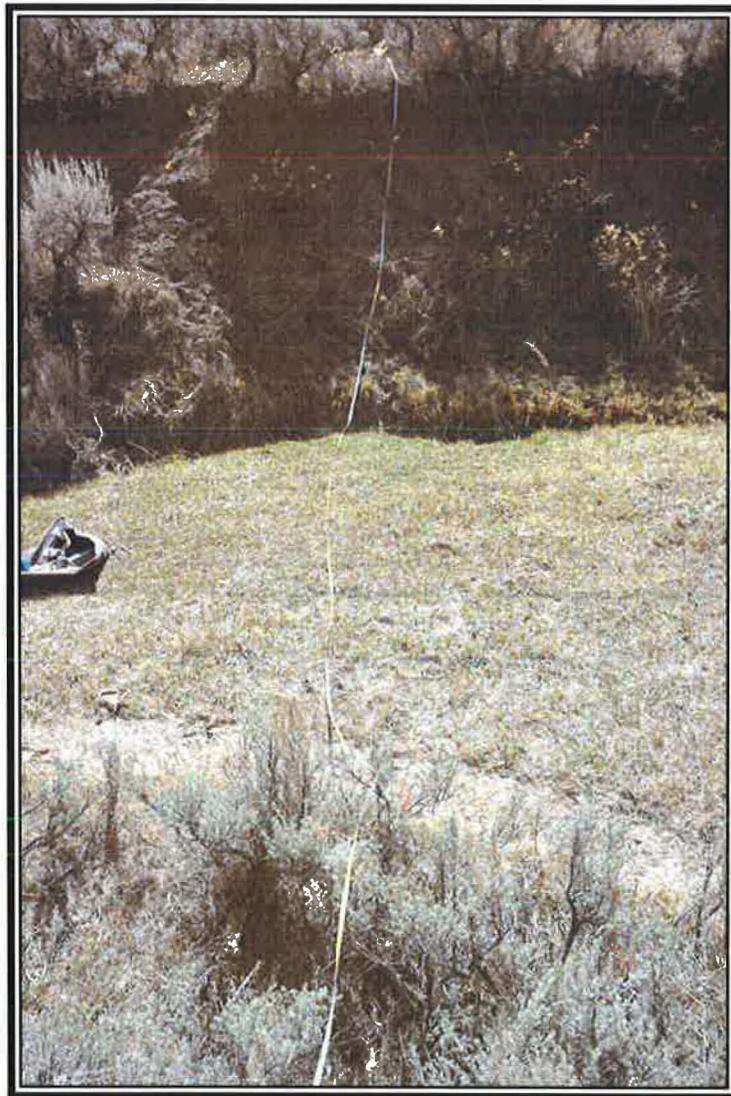
- 1) This site had a straightforward area to monitor the riparian zone.*
- 2) This site is within the current planned subsidence zone.*

## DATA SUMMARY

### Q09C: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2012).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>	9.00		
<i>Artemisia tridentata/Grasses</i>		11.00	
<i>Artemisia tridentata/Grasses</i>			20.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis/Agrostis stolonifera/Ranunculus cymbalaria</i>	13.50	1.00	
			14.50
<b>TOTAL COVER (Upland Species)</b>			20.00
<b>TOTAL COVER (Riparian Species)</b>			14.50
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			1.50
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>36.00</b>

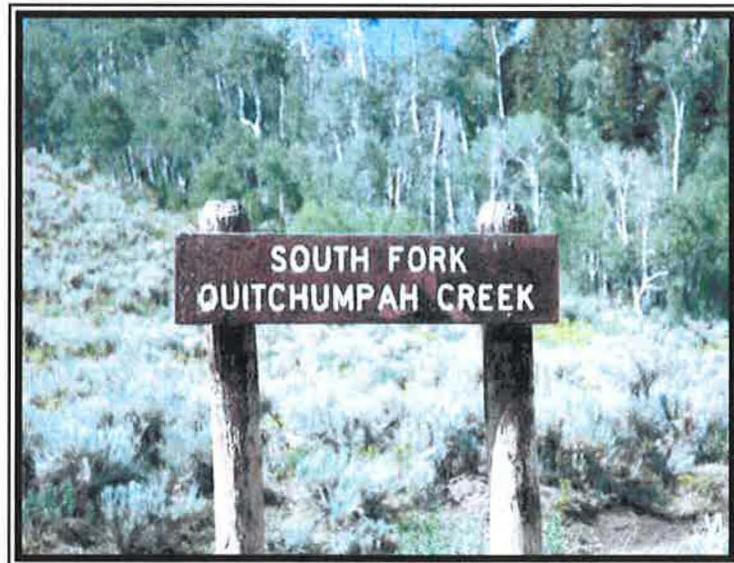
## PHOTOGRAPHIC DOCUMENTATION



Q09C

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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SUFCO MINE  
597 South SR 24  
Salina, Utah 84654

March 2014



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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 Quitcupah 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

<b>TABLE 1: RIPARIAN COMPLEX DATA SHEET</b>	
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 (Quitcupah), 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.

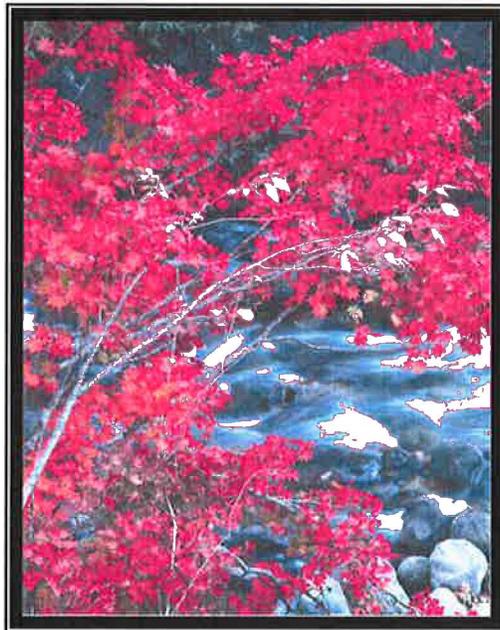


# SECTION A

## 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
<i>(refer to quantitative data results for this information)</i>	

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)
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Achillea millefolium</i>	<i>Juncus arcticus</i>
<i>Salix boothii</i>	<i>Rosa woodsii</i>	<i>Taraxacum officinale</i>	<i>Poa pratensis</i>
	<i>Symphoricarpos oreophilus</i>		

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 (<90°): *0*  
 % bank length gently sloping (>135°): *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:

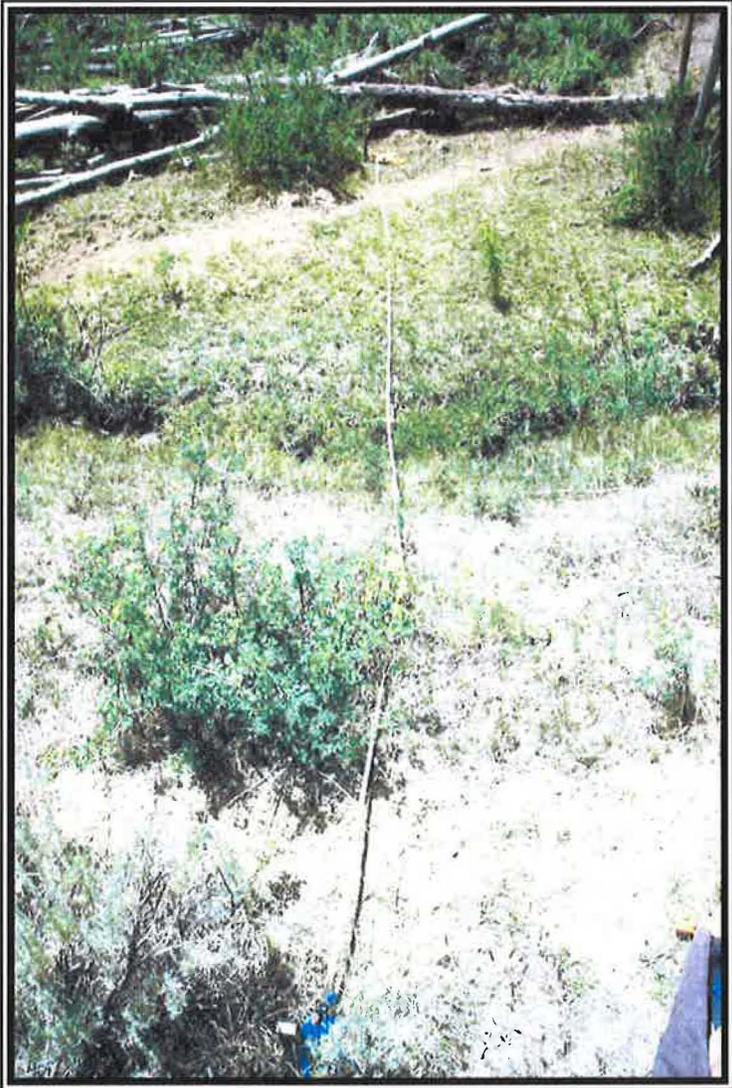
- 1) This is a good creek channel monitoring site. It is outside the cattle trail and readily monitored.*
- 2) Probably a good "control" site (outside the subsidence zone).*
- 3) There was quite a bit of cattle use noticed this sample period.*

## DATA SUMMARY

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

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Symphoricarpos oreophilus/Artemisia tridentata/Poa pratensis</i>	9.50		
<i>Poa pratensis/Taraxacum officinale</i>		10.00	19.50
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Salix boothii</i>	0.50		
<u>Dominant Herbaceous Species</u>			
<i>Juncus arcticus/Rosa woodsii</i>	3.50		
<i>Carex nebrascensis/Juncus arcticus</i>		5.00	9.00
<b>TOTAL COVER (Upland Species)</b>			19.50
<b>TOTAL COVER (Riparian Species)</b>			9.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			1.50
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>30.00</b>

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
<i>(refer to quantitative data results for this information)</i>	

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)
<i>Picea pungens</i>	<i>Ribes sp.</i>	<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Symphoricarpos oreophilus</i>	<i>Equisetum arvense</i>	<i>Carex nebrascensis</i>
		<i>Ranunculus cymbalaria</i>	<i>Poa pratensis</i>
		<i>Taraxacum officinale</i>	

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

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

BANK CONDITION

	<u>Center</u>	<u>Side</u>
% bank length vegetated, stable:	<i>35</i>	<i>60</i>
% bank length unvegetated, stable:	<i>15</i>	<i>20</i>
% bank length vegetated, unstable:	<i>30</i>	<i>5</i>
% bank length unvegetated, unstable:	<i>20</i>	<i>15</i>

NOTES:

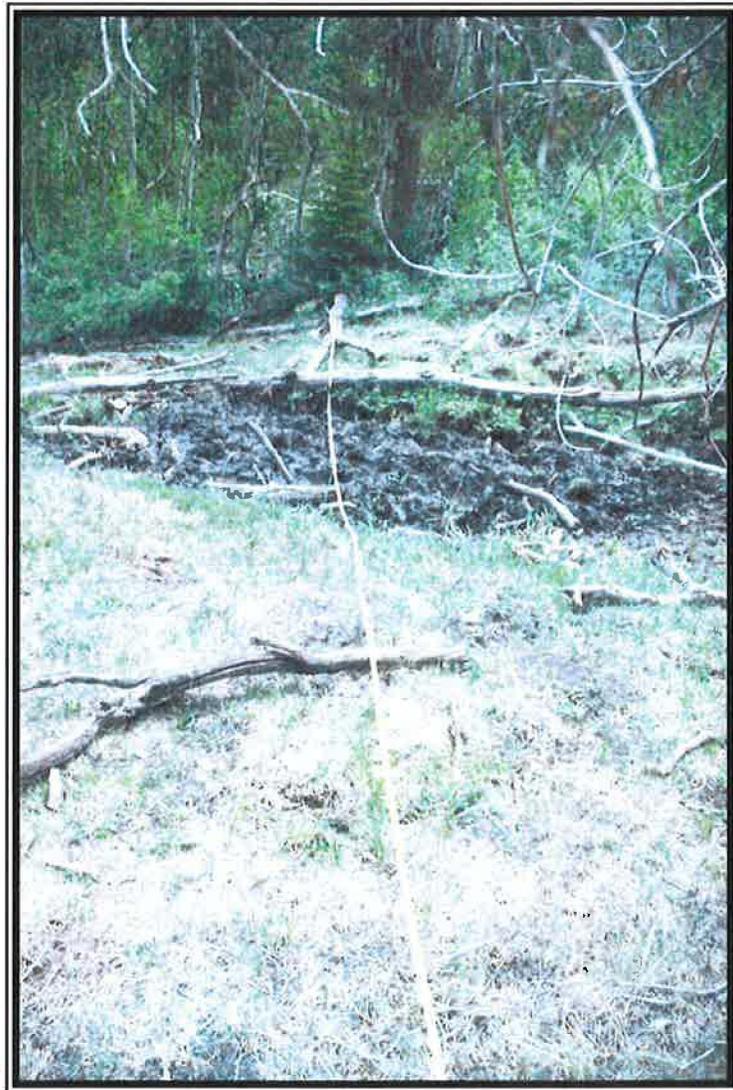
- 1) *This is a spring area.*
- 2) *Probably a good "control" site (outside the subsidence zone).*
- 3) *There were lots of cattle hoof-prints (disturbance).*
- 4) *The Bank Condition represents both the bank and wet areas (refer to the photograph).*
- 5) *The center of the spring was comprised of about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

## DATA SUMMARY

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

<b>USDA Forest Service Protocol (1992)</b>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Poa pratensis</i> / <i>Achillea millefolium</i>	10.00		
<i>Geranium richardsonii</i> / <i>Poa pratensis</i>		8.00	18.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Ranunculus cymbalaria</i> / <i>Agrostis stolonifera</i>		6.00	
<i>Carex nebrascensis</i> / <i>Ranunculus cymbalaria</i>	1.00		7.00
<b>TOTAL COVER (Upland Species)</b>			18.00
<b>TOTAL COVER (Riparian Species)</b>			7.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			4.00
<b>BAREGROUND (channel)</b>			4.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>33.00</b>

## 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
<i>(refer to quantitative data results for this information)</i>	

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)
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Aster sp.</i>	<i>Agrostis stolonifera</i>
	<i>Rosa woodsii</i>	<i>Equisetum arvense</i>	<i>Juncus arcticus</i>
	<i>Salix spp.</i>	<i>Taraxacum officinale</i>	<i>Juncus longistylis</i>

POOL ATTRIBUTES

% area in pools: *0*

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

AQUATIC VEGETATION

% streambed with filamentous algae: *0*

% stream margin with rooted aquatic: *0*

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *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).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Artemisia tridentata/Elymus salinus</i>	10.00		
<i>Populus tremuloides/Juncus arcticus</i>		13.00	
			23.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Juncus arcticus</i>	6.50	4.00	
			10.50
<b>TOTAL COVER (Upland Species)</b>			23.00
<b>TOTAL COVER (Riparian Species)</b>			10.50
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			1.50
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>35.00</b>

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
<i>(refer to quantitative data results for this information)</i>	

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)
<i>Picea pungens</i>	<i>Rosa woodsii</i>	<i>Achillea millefolium</i>	<i>Eleocharis palustris</i>
<i>Populus tremuloides</i>	<i>Salix boothii</i>	<i>Equisetum arvense</i>	<i>Hordeum jubatum</i>
		<i>Geranium richardsonii</i>	<i>Juncus arcticus</i>
			<i>Juncus longistylis</i>
			<i>Poa pratensis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*  
 % bank length gently sloping (>135°): *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).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Symphoricarpos oreophilus/Populus tremuloides</i>	9.00		
<i>Picea pungens/Salix boothii</i>		10.00	
			19.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis/Hordeum jubatum</i>			
<i>Eleocharis palustris/Ranunculus cymbalaria</i>		25.00	
<i>Carex nebrascensis</i>	8.00		
			33.00
<b>TOTAL COVER (Upland Species)</b>			19.00
<b>TOTAL COVER (Riparian Species)</b>			33.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			4.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>56.00</b>

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
<i>(refer to quantitative data results for this information)</i>	

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)
<i>Picea pungens</i>	<i>Salix boothii</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
<i>Pinus flexilis</i>	<i>Symphoricarpos oreophilus</i>	<i>Geranium richardsonii</i>	<i>Carex nebrascensis</i>
<i>Populus tremuloides</i>		<i>Ranunculus cymbalaria</i>	

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

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

<b>USDA Forest Service Protocol (1992)</b>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Salix boothii/Picea pungens</i>	10.00		
<i>Picea pungens/Populus tremuloides</i>		11.00	21.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis/Agrostis stolonifera/Ranunculus cymbalaria</i>	36.00	36.00	72.00
<b>TOTAL COVER (Upland Species)</b>			21.00
<b>TOTAL COVER (Riparian Species)</b>			72.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			0.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>93.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q05S

**RIPARIAN COMPLEX DATA SHEET**  
**July 2013**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q065*

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
<i>(refer to quantitative data results for this information)</i>	

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)
<i>Populus tremuloides</i>	<i>Ribes sp</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
	<i>Salix boothii</i>	<i>Taraxacum officinale</i>	<i>Poa pratensis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*  
 % bank length gently sloping (>135°): *100*  
 % bank length with overhanging vegetation: *25*

BANK CONDITION

% bank length vegetated, stable: *75*  
 % 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).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Populus tremuloides/Salix boothii</i>	3.00		
<i>Symphoricarpos oreophilus/Grasses</i>		5.00	
			8.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Agrostis stolonifera</i>	2.50	2.50	5.00
<b>TOTAL COVER (Upland Species)</b>			8.00
<b>TOTAL COVER (Riparian Species)</b>			5.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			0.00
<b>BAREGROUND (channel)</b>			7.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			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
<i>(refer to quantitative data results for this information)</i>	

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)
	<i>Rosa woodsii</i>	<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
	<i>Salix boothii</i>	<i>Trifolium sp.</i>	<i>Carex nebrascensis</i>
			<i>Hordeum jubatum</i>
			<i>Poa pratensis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *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).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>	0.00		
<i>Poa pratensis/Achillea millefolium</i>		0.00	
<i>Poa pratensis/Achillea millefolium</i>			0.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Rosa woodsii</i>	7.50		
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis/Poa pratensis</i>		10.50	
<i>Carex nebrascensis</i>	24.00	10.00	
<i>Juncus arcticus</i>	2.00		33.50
<b>TOTAL COVER (Upland Species)</b>			0.00
<b>TOTAL COVER (Riparian Species)</b>			54.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			1.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>55.00</b>

## 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
<i>(refer to quantitative data results for this information)</i>	

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)
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Trifolium sp.</i>	<i>Agrostis stolonifera</i>
	<i>Salix boothii</i>		<i>Carex nebrascensis</i>
			<i>Juncus arcticus</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*  
 % bank length gently sloping (>135°): *100 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:

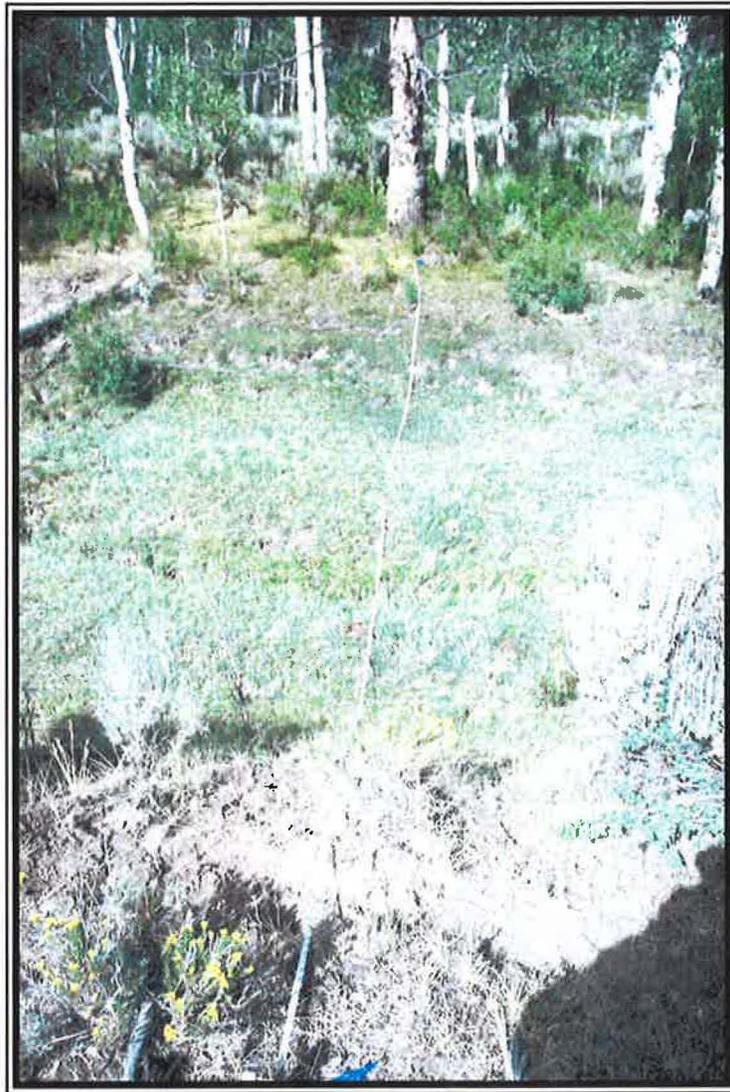
- 1) This site had a straightforward area to monitor the riparian zone. The station went from low water to a low terrace, then a high terrace and finally to the aspen forest.*
- 2) This site is within the current planned subsidence zone.*

## DATA SUMMARY

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

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Artemisia tridentata/Grasses</i>	10.00		
<i>Populus tremuloides/Symphoricarpos oreophilus</i>		11.00	
			21.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Rosa woodsii</i>			
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis</i>	3.00	14.00	
<i>Carex nebrascensis/Agrostis stolonifera/Ranunculus cymbalaria</i>	5.00		
			22.00
<b>TOTAL COVER (Upland Species)</b>			21.00
<b>TOTAL COVER (Riparian Species)</b>			22.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			1.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>44.00</b>

## 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
<i>(refer to quantitative data results for this information)</i>	

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)
	<i>Artemisia tridentata</i>	<i>Trifolium sp.</i>	<i>Agrostis stolonifera</i>
	<i>Rosa woodsii</i>		<i>Juncus arcticus</i>
	<i>Salix boothii</i>		<i>Poa pratensis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *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).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>	10.00		
<i>Artemisia tridentata/Grasses</i>		11.00	
<i>Artemisia tridentata/Grasses</i>			21.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Poa pratensis/Juncus arcticus</i>	13.00		
<i>Equisetum arvensis/Poa pratensis</i>		1.00	
			14.00
<b>TOTAL COVER (Upland Species)</b>			21.00
<b>TOTAL COVER (Riparian Species)</b>			14.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			1.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>36.00</b>

PHOTOGRAPHIC DOCUMENTATION



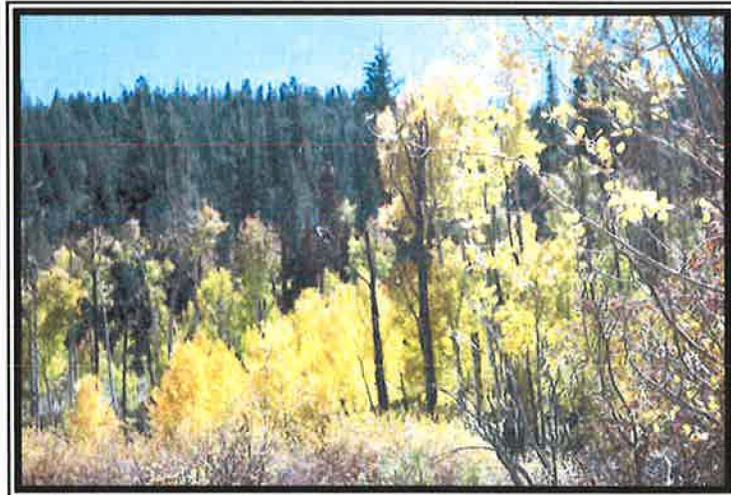
Q09C

# 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
<i>(refer to quantitative data results for this information)</i>	

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)
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Achillea millefolium</i>	<i>Carex nebrascensis</i>
<i>Salix boothii</i>	<i>Rosa woodsii</i>	<i>Taraxacum officinale</i>	<i>Juncus arcticus</i>
	<i>Symphoricarpos oreophilus</i>		<i>Poa pratensis</i>

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 (<90°): *0*  
 % bank length gently sloping (>135°): *0*  
 % bank length with overhanging vegetation: *25 (short Booth's willows)*

BANK CONDITION

% bank length vegetated, stable: *70*  
 % bank length unvegetated, stable: *0*  
 % bank length vegetated, unstable: *25*  
 % bank length unvegetated, unstable: *65*

NOTES:

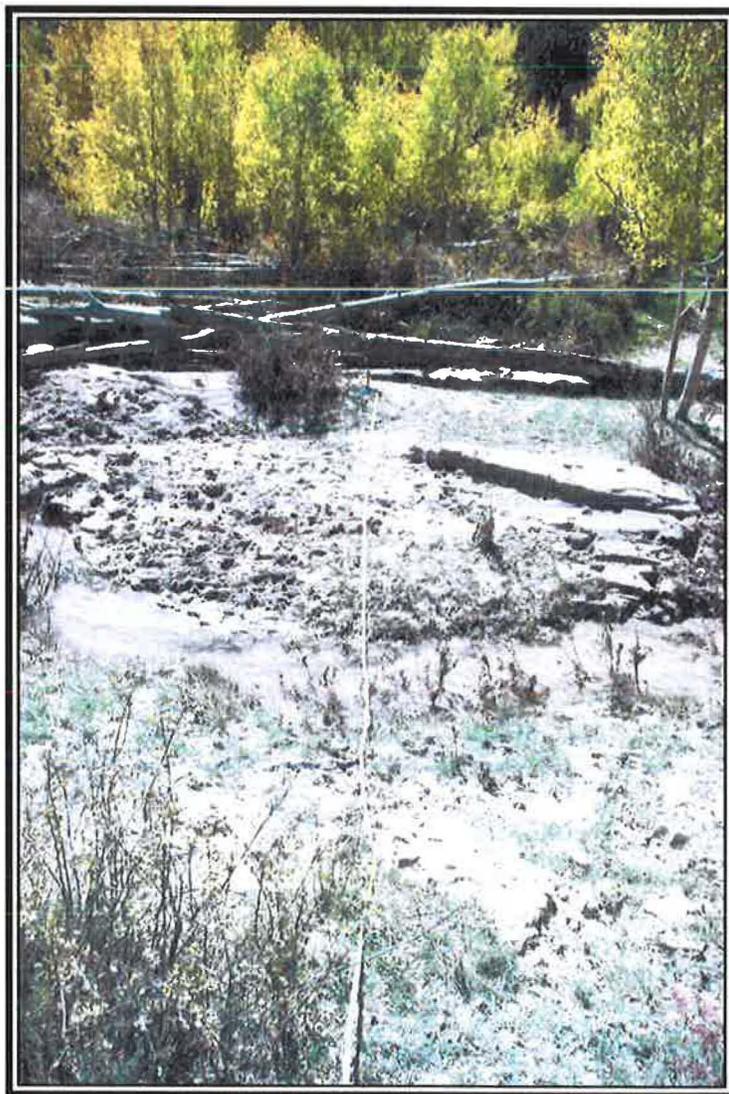
- 1) *This is a stream channel sample site.*
- 2) *This is a good creek channel monitoring site. It is outside the cattle trail and readily monitored.*
- 3) *Probably a good "control" site (outside the subsidence zone).*
- 4) *Cattle were present during this sample period.*
- 5) *All stakes were found.*
- 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).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Symphoricarpos oreophilus/Artemisia tridentata/Poa pratensis</i>	10.00		
<i>Poa pratensis/Taraxacum officinale</i>		10.00	20.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Rosa woodsii</i>	0.50		
<u>Dominant Herbaceous Species</u>			
<i>Juncus arcticus</i>	1.50		
<i>Carex nebrascensis</i>		4.00	6.00
<b>TOTAL COVER (Upland Species)</b>			20.00
<b>TOTAL COVER (Riparian Species)</b>			6.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			4.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>30.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q01C

**RIPARIAN COMPLEX DATA SHEET**  
**October 2013**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q025*

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
<i>(refer to quantitative data results for this information)</i>	

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)
<i>Picea pungens</i>	<i>Ribes sp.</i>	<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Symphoricarpos oreophilus</i>	<i>Equisetum arvense</i>	<i>Carex nebrascensis</i>
		<i>Ranunculus cymbalaria</i>	<i>Poa pratensis</i>
		<i>Taraxacum officinale</i>	

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

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

BANK CONDITION

	<u>Center</u>	<u>Side</u>
% bank length vegetated, stable:	<i>0</i>	<i>60</i>
% bank length unvegetated, stable:	<i>50</i>	<i>20</i>
% bank length vegetated, unstable:	<i>0</i>	<i>5</i>
% bank length unvegetated, unstable:	<i>50</i>	<i>15</i>

NOTES:

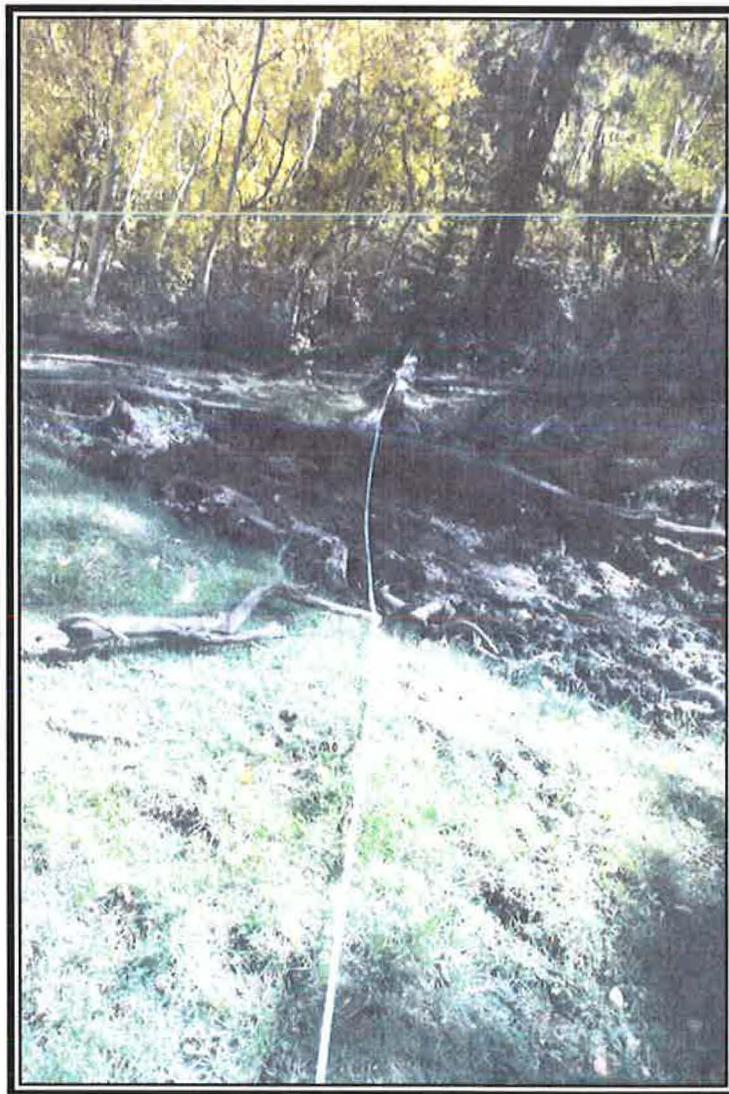
- 1) *This is a spring area.*
- 2) *Probably a good "control" site (outside the subsidence zone).*
- 3) *There were lots of cattle hoof-prints (disturbance).*
- 4) *All stakes were located.*
- 4) *The Bank Condition represents both the bank and wet areas (refer to the photograph).*
- 5) *Lots of cattle 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).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Poa pratensis</i> / <i>Achillea millefolium</i>	10.00		
<i>Geranium richardsonii</i> / <i>Poa pratensis</i>		8.00	
			18.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Ranunculus cymbalaria</i> / <i>Agrostis stolonifera</i>		6.00	
<i>Carex nebrascensis</i>	1.00		
			7.00
<b>TOTAL COVER (Upland Species)</b>			18.00
<b>TOTAL COVER (Riparian Species)</b>			7.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			1.00
<b>BAREGROUND (channel)</b>			7.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>33.00</b>

## 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: *8,370 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
<i>(refer to quantitative data results for this information)</i>	

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)
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Aster sp.</i>	<i>Agrostis stolonifera</i>
	<i>Rosa woodsii</i>	<i>Equisetum arvense</i>	<i>Juncus arcticus</i>
	<i>Salix spp.</i>	<i>Taraxacum officinale</i>	

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0 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:

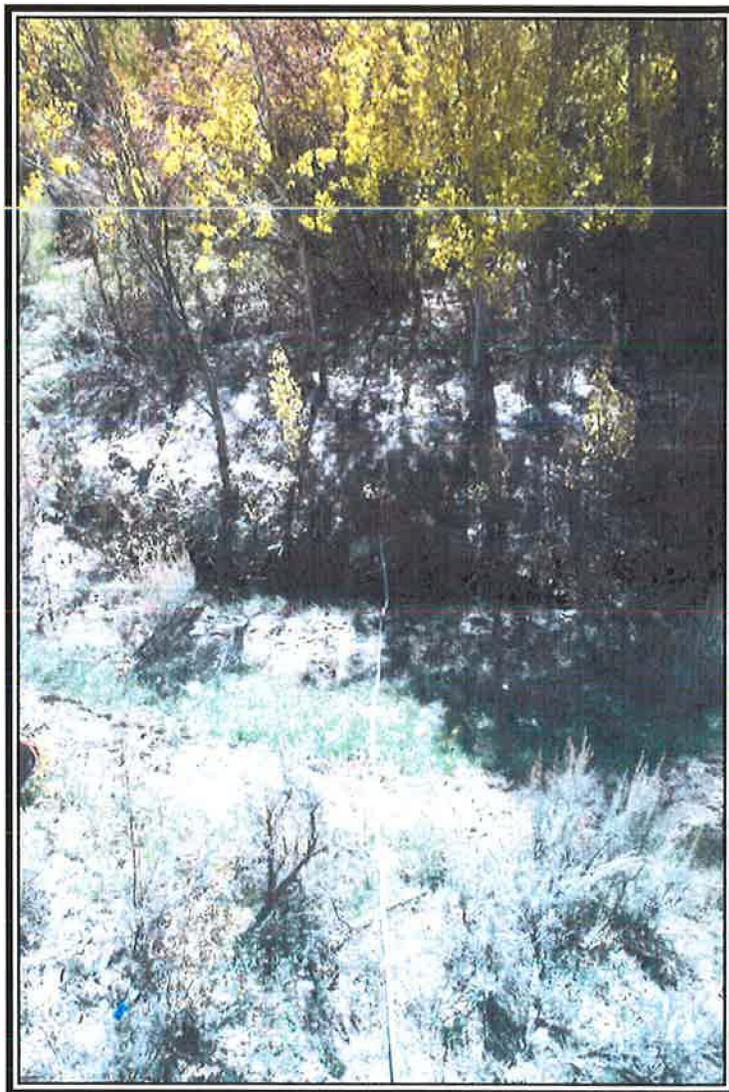
- 1) *This is a channel site.*
- 2) *A good control station; outside current subsidence plans.*
- 3) *It seems like we needed a sample here, but this may be more difficult to monitor as accurately due to the topography. The narrow channel sites are more straight-forward to monitor than this type.*
- 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).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Artemisia tridentata/Elymus salinus</i>	10.00		
<i>Populus tremuloides/Juncus arcticus</i>		13.00	
			23.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Juncus arcticus</i>	8.00	2.00	
			10.00
<b>TOTAL COVER (Upland Species)</b>			23.00
<b>TOTAL COVER (Riparian Species)</b>			10.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			2.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>35.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q03C

**RIPARIAN COMPLEX DATA SHEET**  
**October 2013**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q045*

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: *8,370 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
<i>(refer to quantitative data results for this information)</i>	

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)
<i>Picea pungens</i>	<i>Rosa woodsii</i>	<i>Achillea millefolium</i>	<i>Eleocharis palustris</i>
<i>Populus tremuloides</i>	<i>Salix boothii</i>	<i>Equisetum arvense</i>	<i>Hordeum jubatum</i>
		<i>Geranium richardsonii</i>	<i>Juncus arcticus</i>
			<i>Juncus longistylis</i>
			<i>Poa pratensis</i>

POOL ATTRIBUTES

- % area in pools: *100*
- % pool area made up of pools > 2' deep: *0*

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): *0*
- % bank length gently sloping (>135°): *100*
- % bank length with overhanging vegetation: *50*

BANK CONDITION

- % bank length vegetated, stable: *35*
- % bank length unvegetated, stable: *0*
- % bank length vegetated, unstable: *75*
- % bank length unvegetated, unstable: *50*

NOTES:

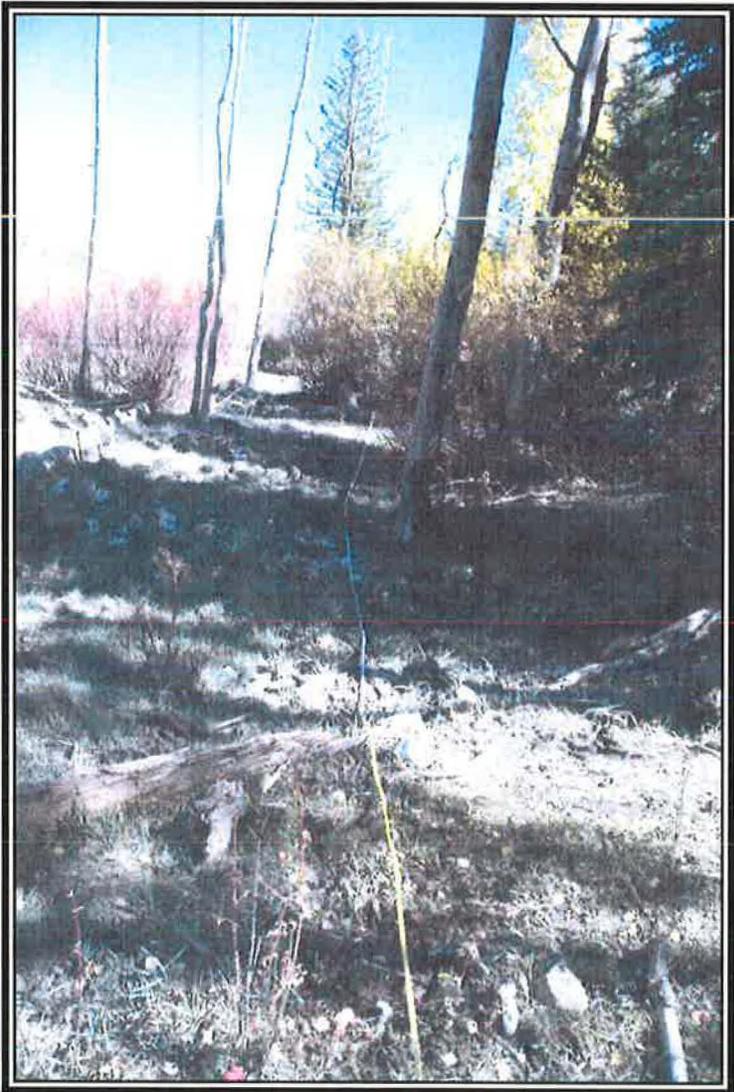
- 1) *This is a spring area.*
- 2) *It is a good control station; outside current subsidence plans.*
- 3) *The spring site had several zones of vegetation based on the different water regimes.*
- 4) *Nebraska sedge and spike rush zones seemed to be the wettest areas.*
- 5) *There was a lot of impact 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).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Symphoricarpos oreophilus/Populus tremuloides</i>	9.00	10.00	19.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Ranunculus cymbalaria/Carex nebrascensis</i>		6.00	6.00
<i>Carex nebrascensis</i>	8.00	6.00	14.00
<b>TOTAL COVER (Upland Species)</b>			19.00
<b>TOTAL COVER (Riparian Species)</b>			20.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			9.00
<b>BAREGROUND (channel)</b>			8.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>56.00</b>

PHOTOGRAPHIC DOCUMENTATION



Q04S

**RIPARIAN COMPLEX DATA SHEET**

**October 2013**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q055*

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
<i>(refer to quantitative data results for this information)</i>	

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)
<i>Picea pungens</i>	<i>Salix boothii</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
<i>Pinus flexilis</i>	<i>Symphoricarpos oreophilus</i>	<i>Geranium richardsonii</i>	<i>Carex nebrascensis</i>
<i>Populus tremuloides</i>		<i>Ranunculus cymbalaria</i>	

POOL ATTRIBUTES

% area in pools: *100*

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

AQUATIC VEGETATION

% streambed with filamentous algae: *0*

% stream margin with rooted aquatic: *0*

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*

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

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Salix boothii/Picea pungens</i>	10.00		
<i>Picea pungens/Populus tremuloides</i>		10.00	
			20.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
 <u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis/Agrostis stolonifera/Ranunculus cymbalaria</i>	36.50	36.50	
			73.00
<b>TOTAL COVER (Upland Species)</b>			20.00
<b>TOTAL COVER (Riparian Species)</b>			73.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			0.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>93.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q05S

**RIPARIAN COMPLEX DATA SHEET**  
**October 2013**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q065*

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
<i>(refer to quantitative data results for this information)</i>	

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)
<i>Populus tremuloides</i>	<i>Ribes sp</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
	<i>Salix boothii</i>	<i>Taraxacum officinale</i>	<i>Poa pratensis</i>

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:

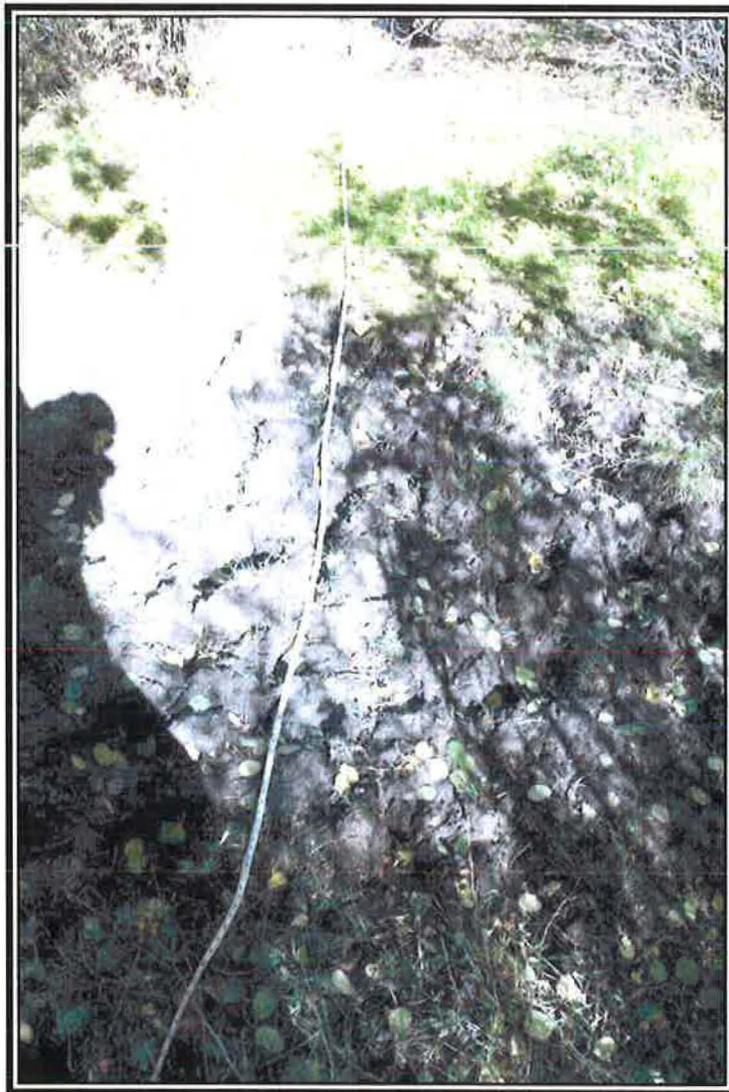
- 1) *Only measured obvious, well-defined spring area.*
- 2) *Left side measured to bank (3 ft).*
- 3) *Cattle had a great impact for this sample period. Therefore, the riparian vegetation was almost all located on the side of the spring channel.*
- 4) *Riparian/wetland vegetation was measured in the 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).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Populus tremuloides/Salix boothii</i>	3.00		
<i>Symphoricarpos oreophilus/Grasses</i>		9.00	12.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Agrostis stolonifera</i>	7.00	1.00	8.00
<b>TOTAL COVER (Upland Species)</b>			12.00
<b>TOTAL COVER (Riparian Species)</b>			8.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			0.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>20.00</b>

## 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
<i>(refer to quantitative data results for this information)</i>	

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)
	<i>Rosa woodsii</i>	<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
	<i>Salix boothii</i>	<i>Trifolium sp.</i>	<i>Carex nebrascensis</i>
			<i>Hordeum jubatum</i>
			<i>Poa pratensis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *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: *70*  
 % bank length vegetated, unstable: *70*  
 % bank length unvegetated, unstable: *70*

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.*

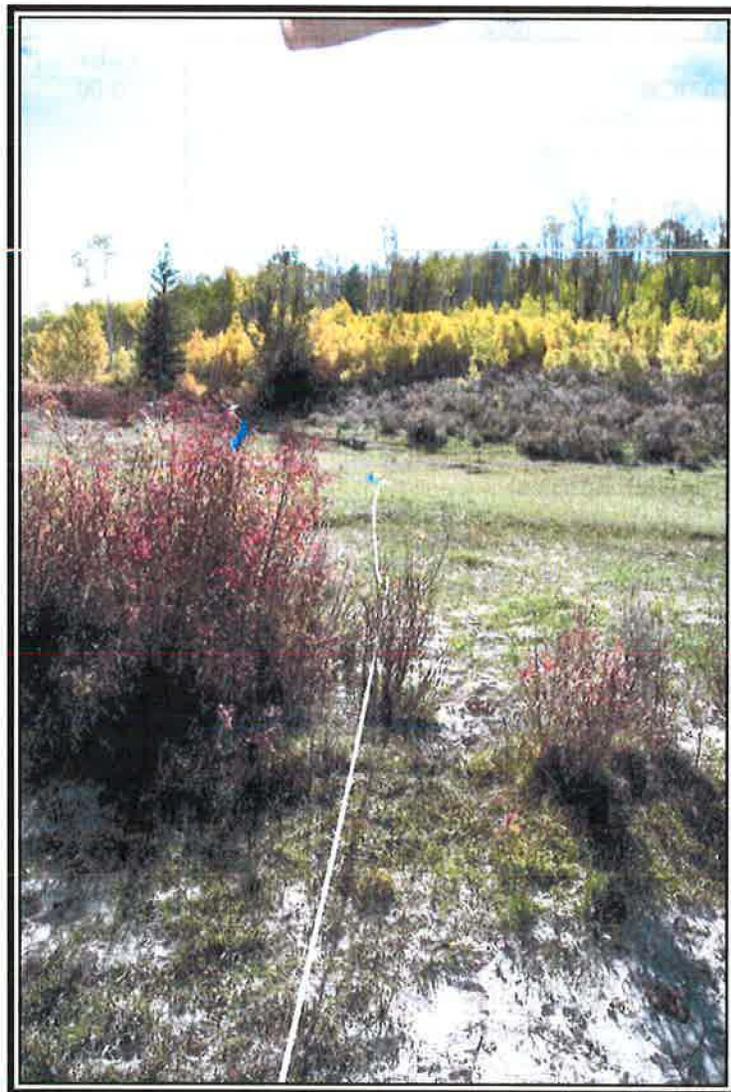
- 5) *This site is within the current planned subsidence zone.*  
 6) *There was cattle at the site when I was sampling*

## DATA SUMMARY

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

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>	0.00		
<i>Poa pratensis/Achillea millefolium</i>		0.00	
<i>Poa pratensis/Achillea millefolium</i>			0.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Rosa woodsii</i>	5.00		
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis</i>	13.50		
<i>Carex nebrascensis/Hordeum jubatum</i>			
<i>Juncus arcticus</i>	28.50	7.00	54.00
<b>TOTAL COVER (Upland Species)</b>			0.00
<b>TOTAL COVER (Riparian Species)</b>			54.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			1.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>55.00</b>

## 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
<i>(refer to quantitative data results for this information)</i>	

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)
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Trifolium sp.</i>	<i>Agrostis stolonifera</i>
	<i>Salix boothii</i>		<i>Carex nebrascensis</i>
			<i>Juncus arcticus</i>

POOL ATTRIBUTES

% area in pools: *25*  
 % pool area made up of pools > 2' deep: *0*

AQUATIC VEGETATION

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

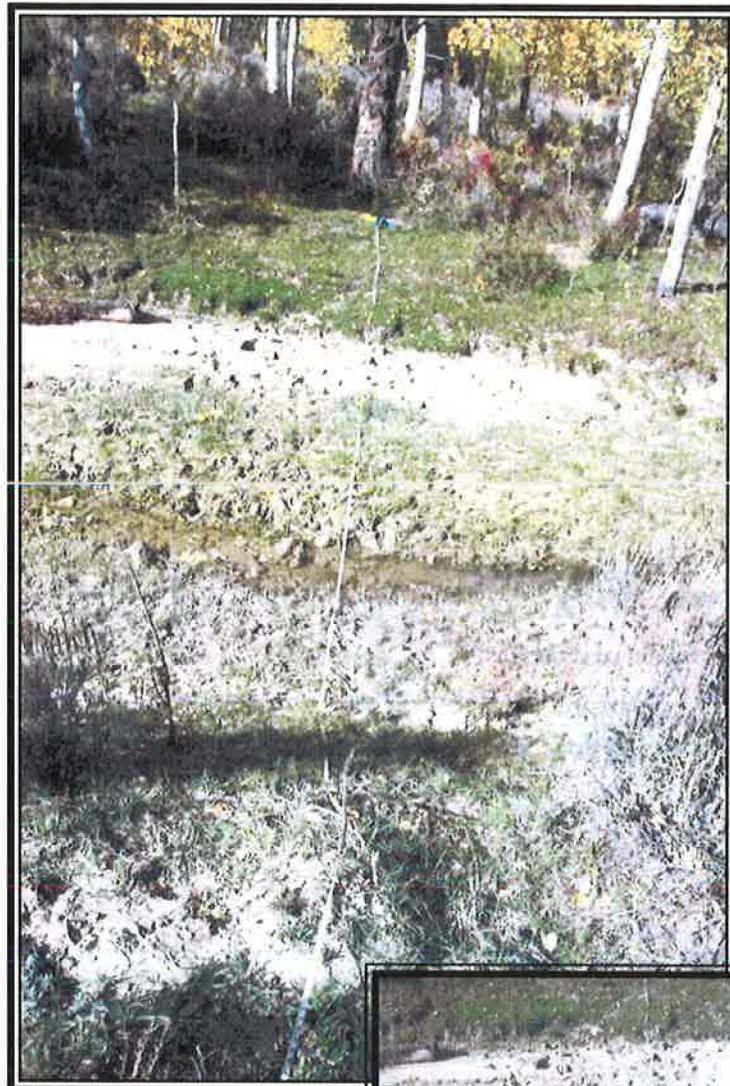
- 1) *This site had a straightforward area to monitor the riparian zone. The station went from low water to a low terrace, then a high terrace and finally to the aspen forest.*
- 2) *This site is within the current planned subsidence zone.*
- 3) *There was evidence of a major flood here since the last 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).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Artemisia tridentata/Grasses</i>	10.00		
<i>Populus tremuloides/Symphoricarpos oreophilus</i>		15.00	
			25.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Rosa woodsii</i>			
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis</i>		9.50	
<i>Carex nebrascensis/Juncus arcticus</i>	6.50		
			16.00
<b>TOTAL COVER (Upland Species)</b>			25.00
<b>TOTAL COVER (Riparian Species)</b>			16.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			3.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>44.00</b>

## 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
<i>(refer to quantitative data results for this information)</i>	

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): *7*

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)
	<i>Artemisia tridentata</i>	<i>Trifolium sp.</i>	<i>Agrostis stolonifera</i>
	<i>Rosa woodsii</i>		<i>Juncus arcticus</i>
	<i>Salix boothii</i>		<i>Poa pratensis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *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:

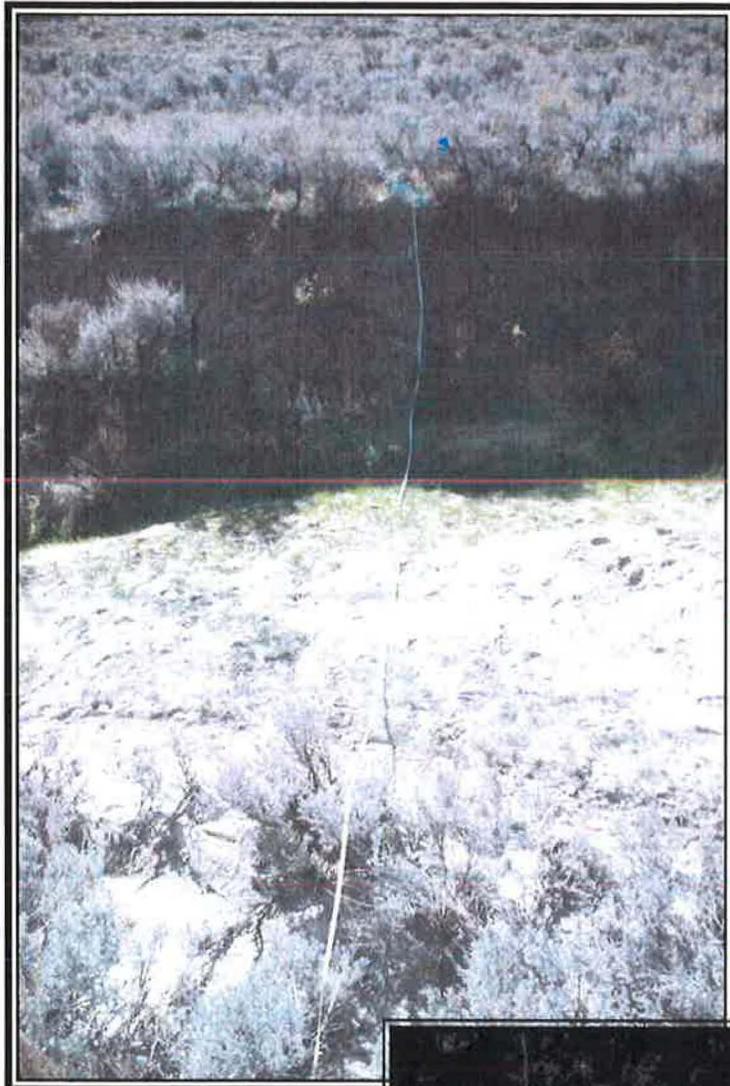
- 1) *This site had a straightforward area to monitor the riparian zone.*
- 2) *This site is within the current planned subsidence zone.*
- 3) *Keep in mind that the transect vegetation width may be consistent, but the total living cover may have decreased within the transect zone due to flooding & deposition. 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).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>	10.00		
<i>Artemisia tridentata/Grasses</i>		10.00	
<i>Artemisia tridentata/Grasses</i>			20.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Equisetum arvense/Poa pratensis</i>		2.00	
<i>Juncus arcticus</i>	12.50		14.50
<b>TOTAL COVER (Upland Species)</b>			20.00
<b>TOTAL COVER (Riparian Species)</b>			14.50
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			1.50
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>36.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q09C



Depositional layer

**RIPARIAN COMPLEX DATA SHEET**  
**October 2013**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q105*

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<sup>o</sup>*

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
<i>(refer to quantitative data results for this information)</i>	

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)
<i>Cornus sericea</i>		<i>Equisetum arvense</i>	
<i>Populus tremuloides</i>		<i>Viola adunca</i>	
<i>Pseudotsuga menziesii</i>			
<i>Rosa woodsii</i>			

POOL ATTRIBUTES

% area in pools: 25  
 % pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 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:

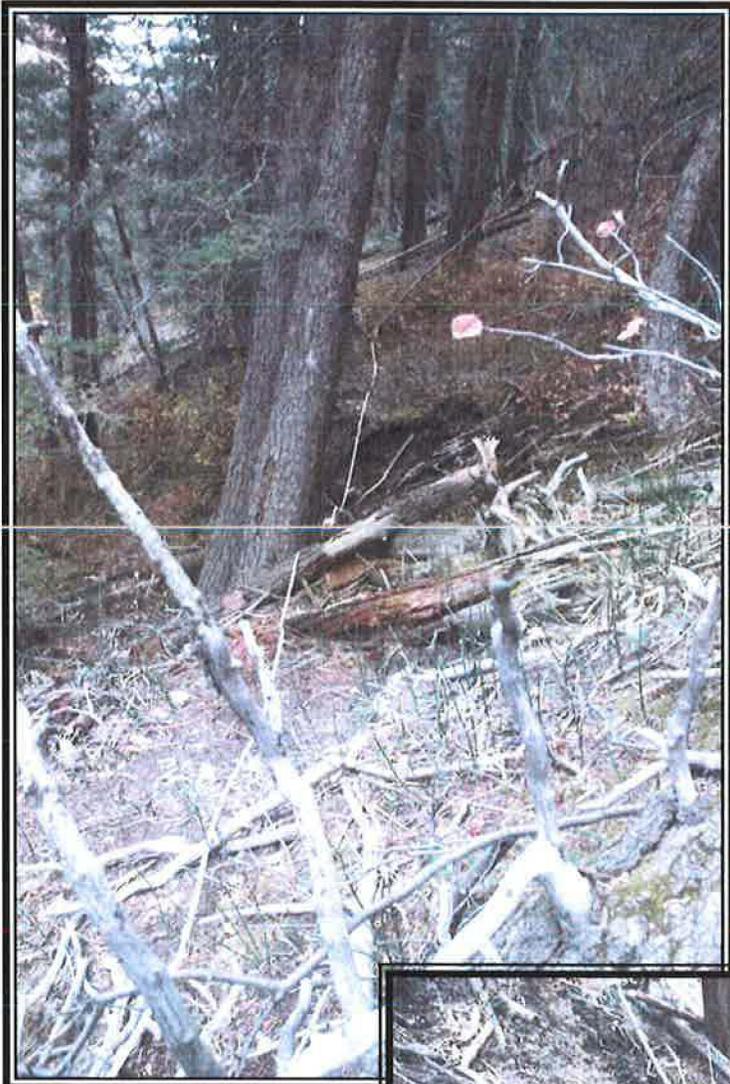
- 1) This site, also called Wedge Spring, is often measured for flow by a hydrologist.
- 2) It had rather low vegetative cover.
- 3) Water surfaced at a couple of locations.
- 4) The bottom-line is that there was not much riparian vegetation and it may be difficult to monitor. There was a great deal 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).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>	0.00		
<i>Conifer</i>		10.00	
<i>Conifer</i>			10.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Cornus sericea/Equisetum arvense</i>		7.00	
<u>Dominant Herbaceous Species</u>			
<i>Equisetum arvense</i>	22.00	22.00	
			51.00
<b>TOTAL COVER (Upland Species)</b>			10.00
<b>TOTAL COVER (Riparian Species)</b>			51.00
<b>ROCK (channel)</b>			4.00
<b>WATER (channel)</b>			4.50
<b>BAREGROUND/MUD (channel)</b>			6.50
<b>LITTER</b>			1.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>77.00</b>

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)
<i>Abies concolor</i>	<i>Chrysothamnus nauseosus</i>	<i>Trifolium sp.</i>	<i>Agrostis stolonifera</i>
<i>Cornus sericea</i>			<i>Juncus arcticus</i>
<i>Populus tremuloides</i>			<i>Poa pratensis</i>
<i>Pseudotsuga menziesii</i>			
<i>Salix lutea?</i>			

POOL ATTRIBUTES

% area in pools: *50*  
 % pool area made up of pools > 2' deep: *0*

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*  
 % bank length gently sloping (>135°): *0*  
 % bank length with overhanging vegetation: *50*

BANK CONDITION

% bank length vegetated, stable: *30*  
 % bank length unvegetated, stable: *20*  
 % bank length vegetated, unstable: *30*  
 % bank length unvegetated, unstable: *20*

NOTES:

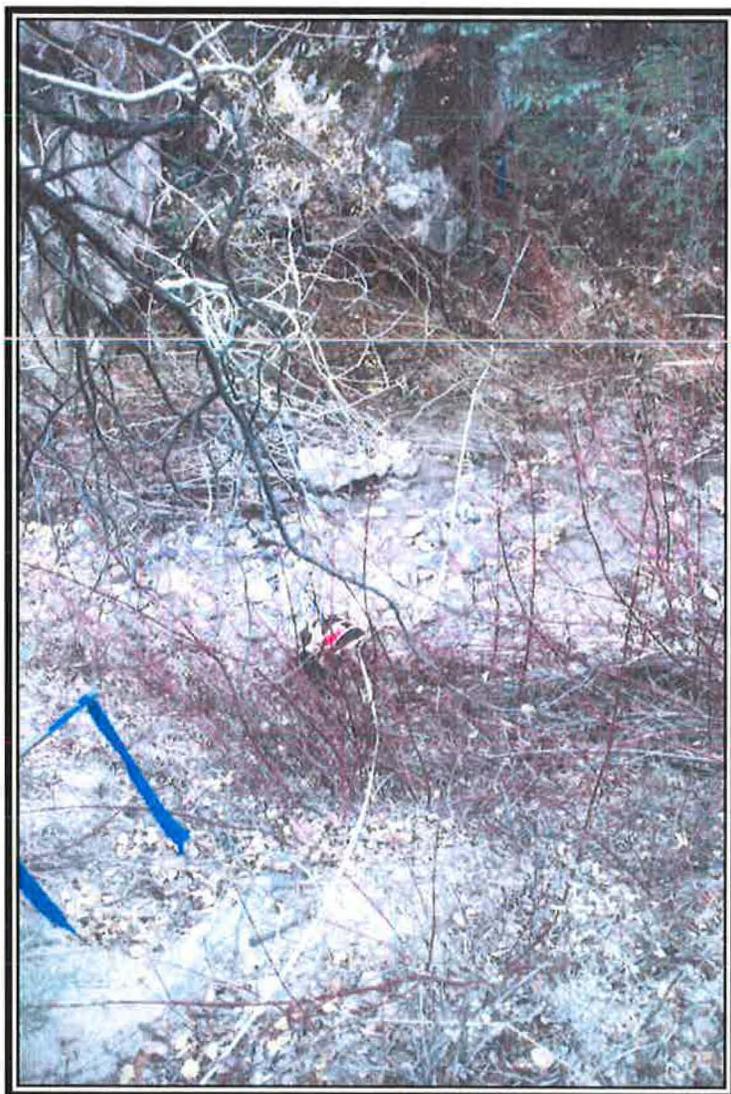
- 1) *Because of recent mining expansion plans, this was the first sample period for this station.*
- 2) *Recent flooding appears to have greatly impacted the riparian community here.*
- 3) *This site was placed at water sampling station (called 006D).*

## DATA SUMMARY

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

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Populus tremuloides/Abies concolor</i>	6.00		
<i>Pseudotsuga menziesii</i>		2.00	8.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Cornus sericea</i>	5.00	6.00	11.00
<u>Dominant Herbaceous Species</u>			
<b>TOTAL COVER (Upland Species)</b>			8.00
<b>TOTAL COVER (Riparian Species)</b>			11.00
<b>ROCK (channel)</b>			6.00
<b>WATER (channel)</b>			5.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER</b>			0.00
<b>MOSS</b>			0.00
<b>TOTAL COVER</b>			<b>30.00</b>

## 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

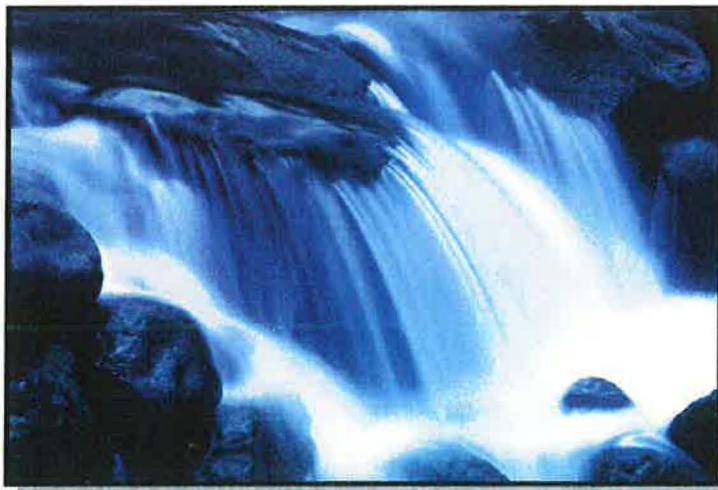


RIPARIAN PLANT COMMUNITY  
MONITORING IN SELECTED REACHES:  
SOUTH FORK QUITCHUPAH CREEK

July & October

2014

FOR THE  
SUFCO MINE  
SEVIER COUNTY, UTAH



*Prepared by*

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SUFCO MINE  
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March 2015



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# Introduction

Recently, the SUFCO Coal Mine expanded their underground operations adjacent to 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. Similar to 2013, the results include two sample periods in 2014 – July and October.

## 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 Quitcupah 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 topographical features, the intent was to make the transects long enough to cover

**TABLE 1: RIPARIAN COMPLEX DATA SHEET**

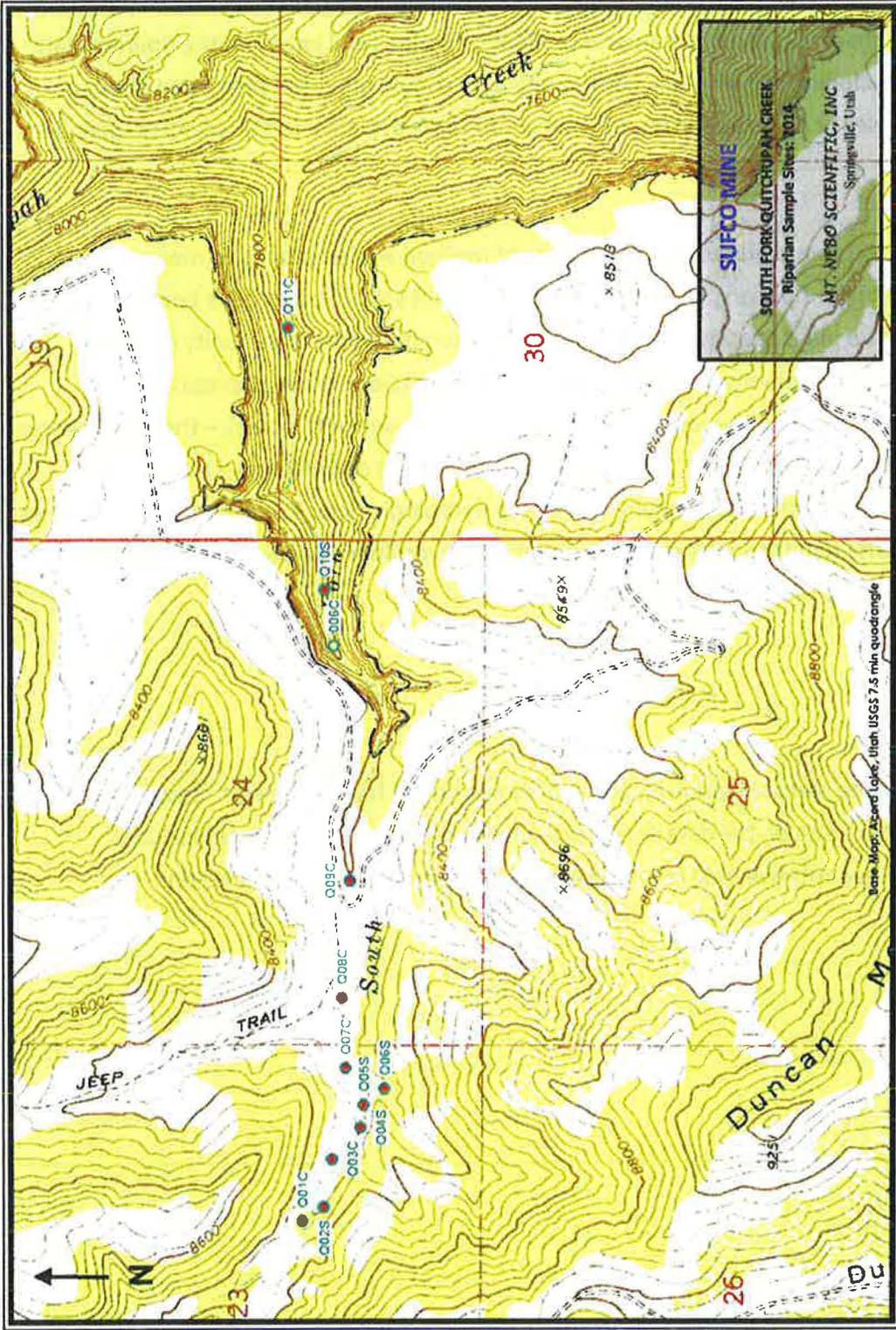
CLIENT:  
SAMPLE NUMBER:  
WATERBODY NAME:  
LOCATION:  
DATE:  
OBSERVER(S):  
QUAD NAME:  
GEOLOGIC PARENT MATERIAL:  
STREAM ASPECT:  
STREAM GRADIENT:  
ELEVATION: .  
SIZE OF COMPLEX:  
ADJACENT UPLAND VEGETATION (looking downstream)  
Left: Right:  
VEGETATIVE DESCRIPTION (Dominance by Community 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:

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*. Finally, each sample site was numbered sequentially and by the hydrologic type. For example, **Q01C** refers to the creek name (Quitcupah), 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.

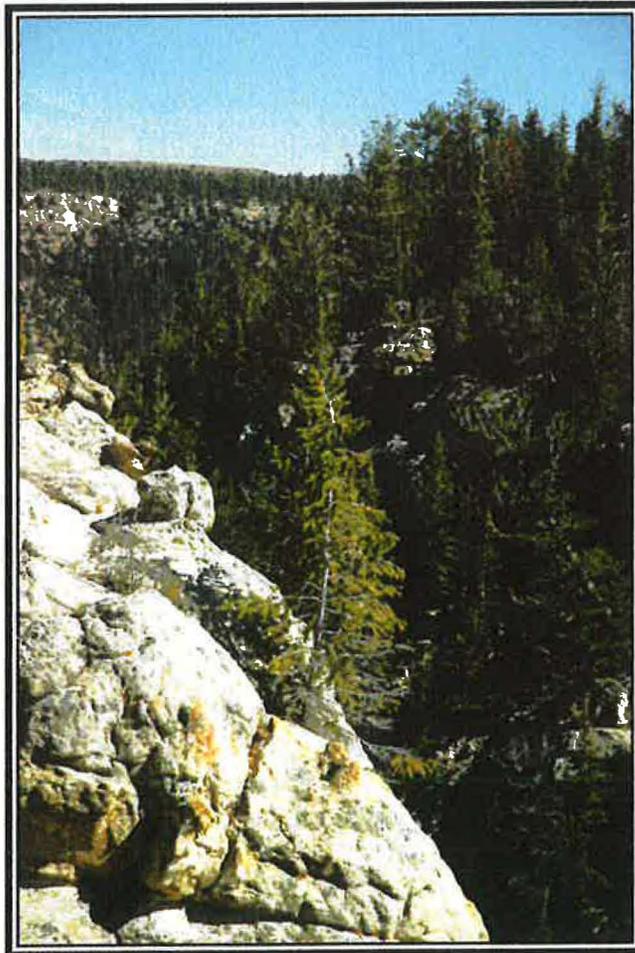


# SECTION A

## RIPARIAN COMPLEX DATA SHEETS

for the

JULY 2014  
SAMPLE PERIOD



**RIPARIAN COMPLEX DATA SHEET**  
**July 2014**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q01C*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *July 15-17, 2014*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

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

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *600 lbs/acre*

BEAVER ACTIVITY: *no*

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

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)
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
<i>Salix boothii</i>	<i>Rosa woodsii</i>	<i>Taraxacum officinale</i>	<i>Carex nebrascensis</i>
	<i>Symphoricarpos oreophilus</i>		<i>Juncus arcticus</i>
			<i>Poa pratensis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

% streambed with filamentous algae: *0*  
 % stream margin with rooted aquatic: *25*

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*  
 % bank length gently sloping (>135°): *50 (right side)*  
 % 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:

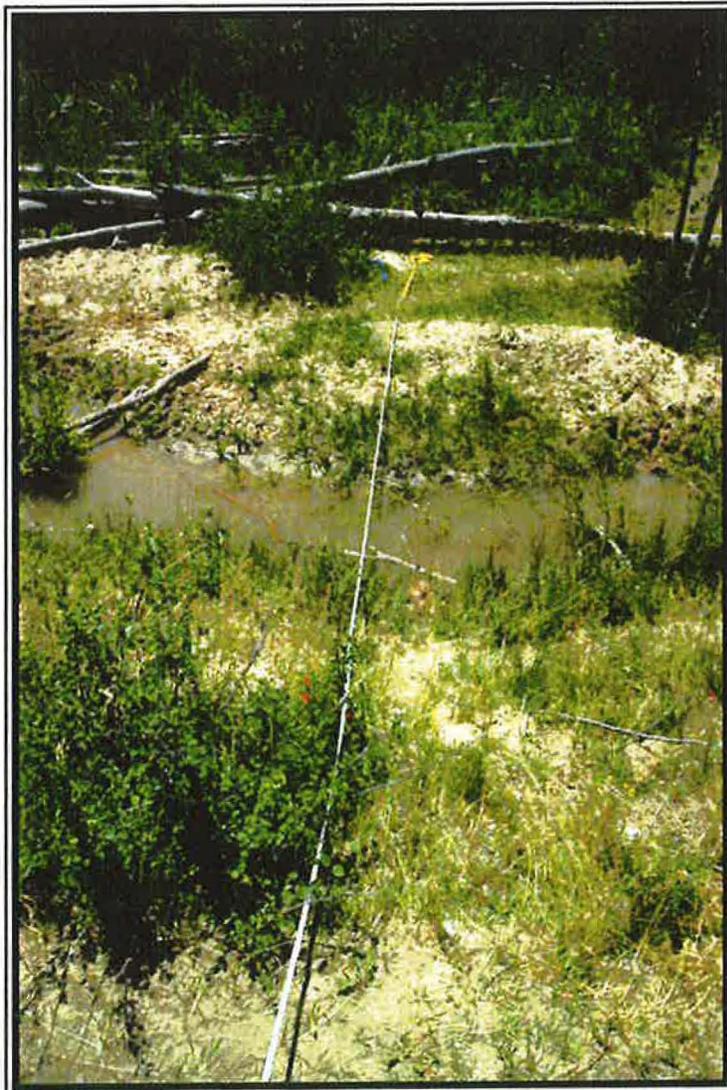
- 1) *This is a good creek channel monitoring site. It is outside the cattle trail and readily monitored.*
- 2) *Probably a good "control" site (outside the subsidence zone).*
- 3) *There was quite a bit of cattle use noticed this sample period.*

## DATA SUMMARY

### Q01C: Cover by plant community types in the South Fork Quitchupah Creek drainage (July 2014).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Symphoricarpos oreophilus/Artemisia tridentata/Poa pratensis</i>	10.00		
<i>Poa pratensis/Taraxacum officinale</i>		10.00	20.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Salix boothii</i>			
<u>Dominant Herbaceous Species</u>			
<i>Agrostis stolonifera/Juncus arcticusi</i>	2.00		
<i>Carex nebrascensis/Agrostis stolonifera</i>		4.00	6.00
<b>TOTAL COVER (Upland Species)</b>			20.00
<b>TOTAL COVER (Riparian Species)</b>			6.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			4.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>30.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q01C

**RIPARIAN COMPLEX DATA SHEET**  
**July 2014**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: **Q025**

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *July 15-17, 2014*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

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 =5; outside=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)
<i>Picea pungens</i>	<i>Ribes sp.</i>	<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Symphoricarpos oreophilus</i>	<i>Equisetum arvense</i>	<i>Carex nebrascensis</i>
		<i>Ranunculus cymbalaria</i>	<i>Poa pratensis</i>
		<i>Taraxacum officinale</i>	

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

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

BANK CONDITION

	<u>Center</u>	<u>Side</u>
% bank length vegetated, stable:	<i>20</i>	<i>70</i>
% bank length unvegetated, stable:	<i>20</i>	<i>20</i>
% bank length vegetated, unstable:	<i>30</i>	<i>5</i>
% bank length unvegetated, unstable:	<i>30</i>	<i>5</i>

NOTES:

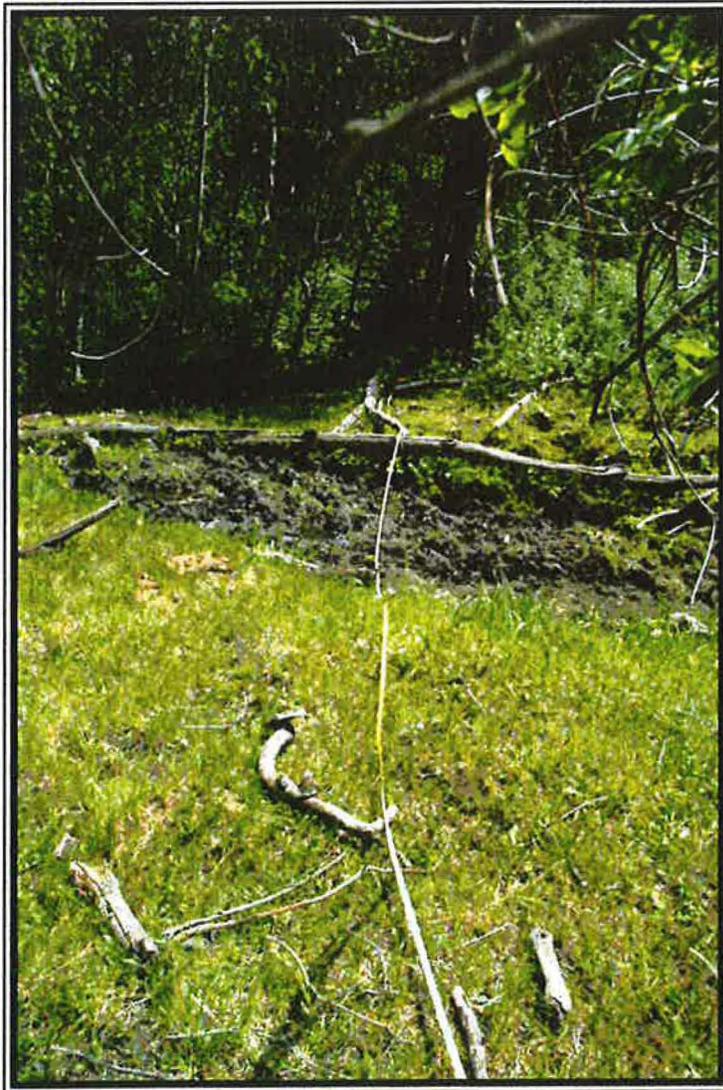
- 1) *This is a spring area.*
- 2) *Probably a good "control" site (outside the subsidence zone).*
- 3) *There were lots of cattle hoof-prints (disturbance).*
- 4) *The Bank Condition represents both the bank and wet areas (refer to the photograph).*
- 5) *The center of the spring was comprised of about 40% water and 60% mud.*

## DATA SUMMARY

### Q02S: Cover by plant community types in the South Fork Quitchupah Creek drainage (July 2014).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Poa pratensis</i> / <i>Achillea millefolium</i> <i>Geranium richardsonii</i> / <i>Poa pratensis</i>	10.00	9.00	19.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u> <i>Ranunculus cymbalaria</i> / <i>Agrostis stolonifera</i> <i>Carex nebrascensis</i>	1.00	5.00	6.00
<b>TOTAL COVER (Upland Species)</b>			19.00
<b>TOTAL COVER (Riparian Species)</b>			6.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			5.00
<b>BAREGROUND (channel)</b>			3.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>33.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q02S

# RIPARIAN COMPLEX DATA SHEET

July 2014

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q03C*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *July 15-17, 2014*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

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

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *850 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)
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Aster sp.</i>	<i>Agrostis stolonifera</i>
	<i>Rosa woodsii</i>	<i>Equisetum arvense</i>	<i>Juncus arcticus</i>
	<i>Salix spp.</i>	<i>Taraxacum officinale</i>	<i>Juncus longistylis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

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

BANK CONDITION

% bank length vegetated, stable: *75*  
 % bank length unvegetated, stable: *15*  
 % bank length vegetated, unstable: *0*  
 % bank length unvegetated, unstable: *10*

NOTES:

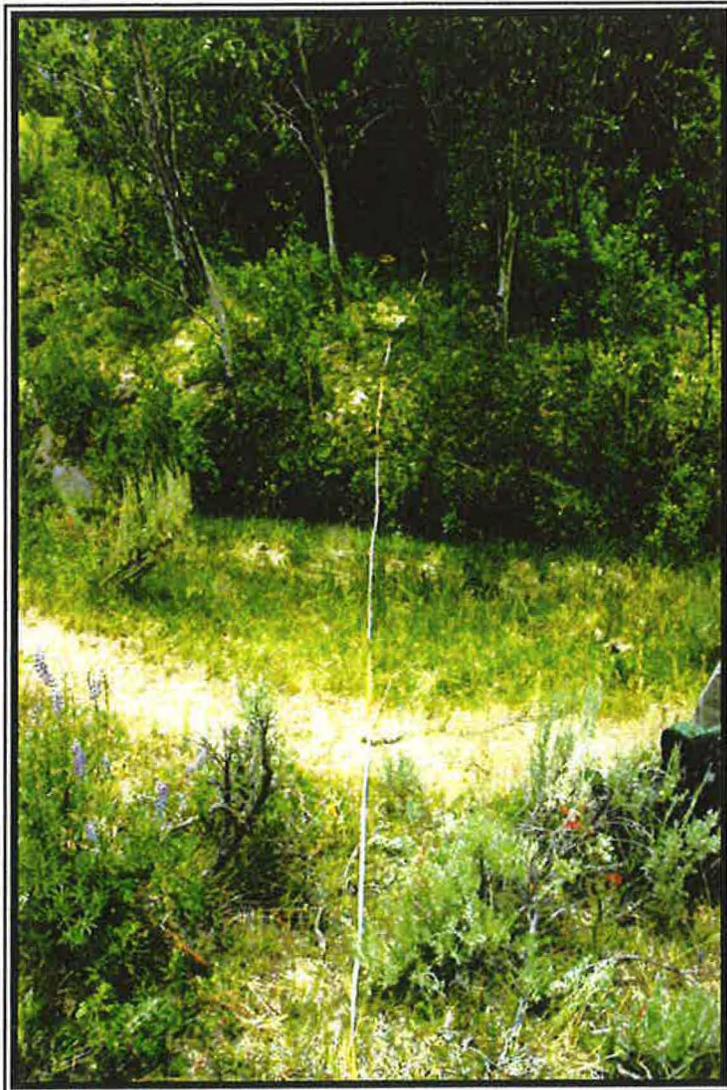
- 1) *This is a channel site.*
- 2) *A good control station; outside current subsidence plans.*
- 3) *It seems like we needed a sample here, but this may be more difficult to monitor as accurately due to the topography. The narrow channel sites are more straight-forward to monitor than this type.*
- 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 2014).

<b>USDA Forest Service Protocol (1992)</b>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Artemisia tridentata/Elymus salinus</i>	10.00		
<i>Populus tremuloides/Juncus arcticus</i>		14.00	
			24.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis</i>	2.00		
<i>Juncus arcticus</i>		4.50	
<i>Agrostis stolonifera</i>	3.00		10.50
<b>TOTAL COVER (Upland Species)</b>			24.00
<b>TOTAL COVER (Riparian Species)</b>			9.50
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			1.50
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>35.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q03C

**RIPARIAN COMPLEX DATA SHEET**  
**July 2014**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q045*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *July 15-17, 2014*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Early in spring (cattle impact); Late outside spring*

APPARENT FORAGE TREND: *Stable & unstable (unstable in spring to cattle)*

ESTIMATED FORAGE PRODUCTION: *700 lbs/acre*

BEAVER ACTIVITY: *Beaver chewing on tree from the past*

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)
<i>Picea pungens</i>	<i>Rosa woodsii</i>	<i>Achillea millefolium</i>	<i>Eleocharis palustris</i>
<i>Populus tremuloides</i>	<i>Salix boothii</i>	<i>Equisetum arvense</i>	<i>Hordeum jubatum</i>
		<i>Geranium richardsonii</i>	<i>Juncus arcticus</i>
			<i>Juncus longistylis</i>
			<i>Poa pratensis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*  
 % bank length gently sloping (>135°): *100*  
 % bank length with overhanging vegetation: *50*

BANK CONDITION

Spring/mud area

% 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. In July 2014, in the spring area, there was 50% water, 50% mud.*
- 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) *In the spring area, it varied from vegetation to mud to bareground.*

## DATA SUMMARY

### Q04S: Cover by plant community types in the South Fork Quitchupah Creek drainage (July 2014).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Symphoricarpos oreophilus/Populus tremuloides</i>	9.00		
<i>Picea pungens/Salix boothii</i>		10.00	
			19.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Agrostis stolonifera/Ranunculus cymbalaria</i>		7.00	
<i>Carex nebrascensis</i>	9.00	13.00	
			29.00
<b>TOTAL COVER (Upland Species)</b>			19.00
<b>TOTAL COVER (Riparian Species)</b>			29.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			3.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MUD (channel)</b>			5.00
<b>TOTAL COVER</b>			<b>56.00</b>

## PHOTOGRAPHIC DOCUMENTATION



**RIPARIAN COMPLEX DATA SHEET**  
**July 2014**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: **Q055**

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *July 15-17, 2014*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Late*

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *750 lbs/acre*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *4 in spring/riparian area (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)
<i>Picea pungens</i>	<i>Salix boothii</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
<i>Pinus flexilis</i>	<i>Symphoricarpos oreophilus</i>	<i>Geranium richardsonii</i>	<i>Carex nebrascensis</i>
<i>Populus tremuloides</i>		<i>Ranunculus cymbalaria</i>	

POOL ATTRIBUTES

% area in pools: *100 (in hoof-prints)*  
 % 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 (in spring/riparian area)

% bank length vegetated, stable: *50*  
 % bank length unvegetated, stable: *10*  
 % bank length vegetated, unstable: *15*  
 % bank length unvegetated, unstable: *25*

NOTES:

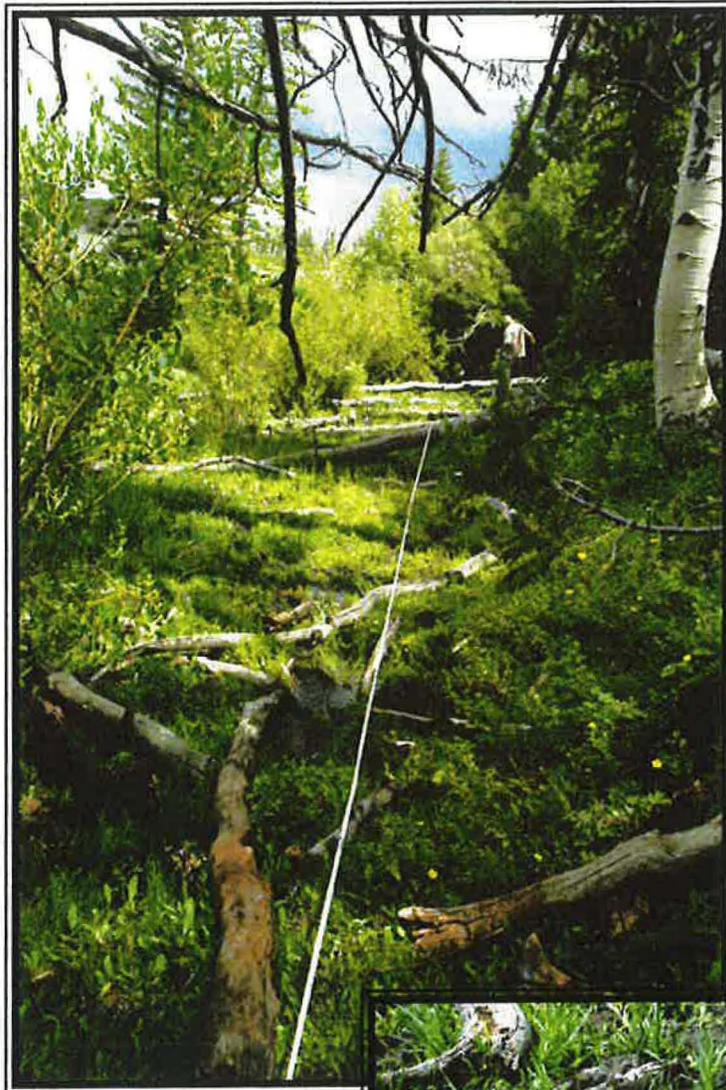
- 1) *This is a well-defined spring area.*
- 2) *A good control station; it is just outside current subsidence plans.*
- 3) *When I placed the transect tape, it formed a "U" shape to measure. This tape was placed 4 ft from the upland bank for 72 ft of riparian/spring vegetation.*
- 4) *For this sample 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, water and mud present in the spring at the transect line.*
- 7) *In areas along the transect line the vegetation cover was ~40%; 30% water pockets; 30% mud.*

## DATA SUMMARY

### Q05S: Cover by plant community types in the South Fork Quitchupah Creek drainage (July 2014).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Salix boothii/Picea pungens</i>	10.00		
<i>Picea pungens/Populus tremuloides</i>		9.00	
			19.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis/Agrostis stolonifera/Ranunculus cymbalaria</i>	37.00	37.00	
			74.00
<b>TOTAL COVER (Upland Species)</b>			19.00
<b>TOTAL COVER (Riparian Species)</b>			74.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			0.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>93.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q05S



Q05S (close up)

**RIPARIAN COMPLEX DATA SHEET**  
**July 2014**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: **Q065**

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *July 15-17, 2014*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Late*

APPARENT FORAGE TREND: *Stable (adjacent spring); unstable (in spring)*

ESTIMATED FORAGE PRODUCTION: *100 lbs/acre in spring; 350 adjacent spring*

BEAVER ACTIVITY: *no*

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

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)
<i>Populus tremuloides</i>	<i>Ribes sp</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
	<i>Salix boothii</i>	<i>Taraxacum officinale</i>	<i>Poa pratensis</i>

POOL ATTRIBUTES

% area in pools: *0, dry, some moist soil though*  
 % 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 (in spring depression)

% bank length vegetated, stable: *75*  
 % 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 and 1 ft up left bank.*
- 5) *Vegetation cover was 25% spring area (75% moist mud).*
- 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 2014).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Populus tremuloides/Salix boothii</i>	3.00		
<i>Symphoricarpos oreophilus/Grasses</i>		9.00	12.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Juncus arcticus</i>	4.00	4.00	8.00
<b>TOTAL COVER (Upland Species)</b>			12.00
<b>TOTAL COVER (Riparian Species)</b>			8.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			0.00
<b>BAREGROUND (channel)</b>			7.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>20.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q06S

**RIPARIAN COMPLEX DATA SHEET**  
**July 2014**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: **Q07C**

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *July 15-17, 2014*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Mid-*

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *1,200 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)
	<i>Rosa woodsii</i>	<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
	<i>Salix boothii</i>	<i>Trifolium sp.</i>	<i>Carex nebrascensis</i>
			<i>Hordeum jubatum</i>
			<i>Poa pratensis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *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 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.*
- 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.*

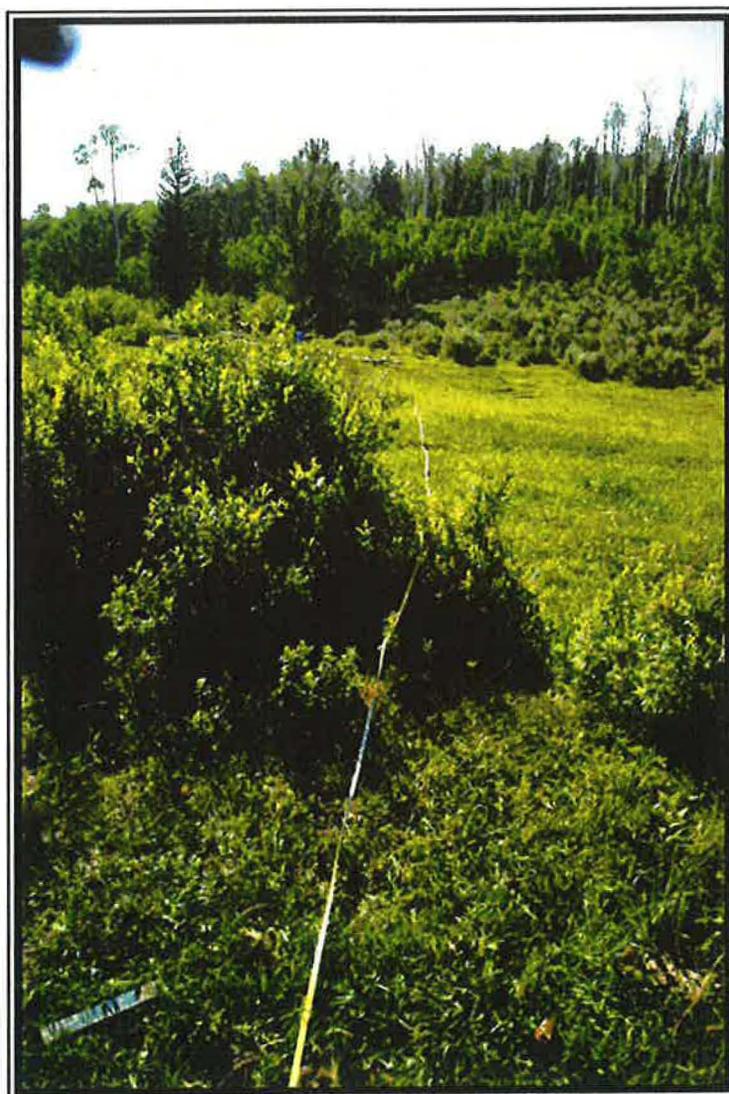
4) This site is within the current planned subsidence zone.

## DATA SUMMARY

### Q07C: Cover by plant community types in the South Fork Quitchupah Creek drainage (July 2014).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>	0.00		
<i>Poa pratensis/Achillea millefolium</i>		0.00	
<i>Poa pratensis/Achillea millefolium</i>			0.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Rosa woodsii</i>	7.00		
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis/Poa pratensis</i>		20.00	
<i>Carex nebrascensis/Juncus arcticus</i>	10.00		
<i>Agrostis stolonifera/Ranunculus cymbalaria</i>	17.00		54.00
<b>TOTAL COVER (Upland Species)</b>			0.00
<b>TOTAL COVER (Riparian Species)</b>			54.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			1.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>55.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q07C

**RIPARIAN COMPLEX DATA SHEET**  
**July 2014**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: **Q08C**

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *July 15-17, 2014*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

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*

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)
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Trifolium sp.</i>	<i>Agrostis stolonifera</i>
	<i>Salix boothii</i>		<i>Carex nebrascensis</i>
			<i>Juncus arcticus</i>
			<i>Poa pratensis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): *0*
- % bank length gently sloping (>135°): *100 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:

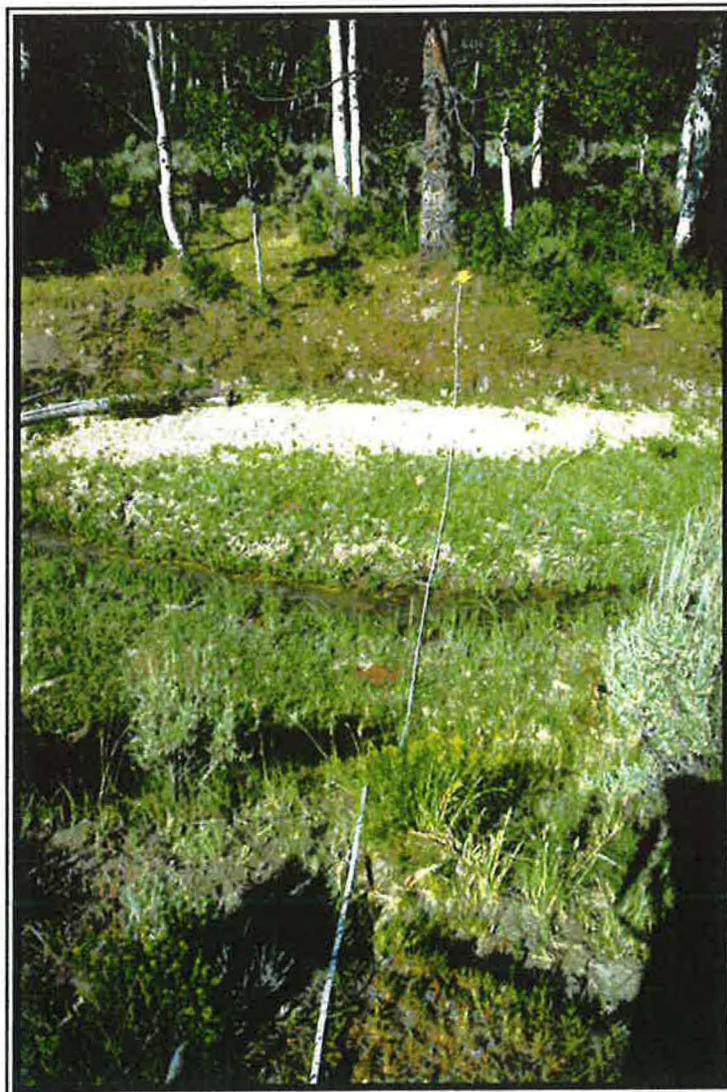
- 1) *This site had a straightforward area to monitor the riparian zone. The station went from low water to a low terrace, then a high terrace and finally to the aspen forest.*
- 2) *This site is within the current planned subsidence zone.*
- 3) *A 2013 precipitation event left a lot of sand outside the right side bank. This covered some of the riparian vegetation, so it reduced the riparian width (see Notes from July 2013).*
- 4) *Also, the water width was greater also decreasing riparian width by about 1 ft.*

## DATA SUMMARY

### Q08C: Cover by plant community types in the South Fork Quitchupah Creek drainage (July 2014).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Artemisia tridentata/Grasses</i>	10.00		
<i>Populus tremuloides/Symphoricarpos oreophilus</i>		16.00	26.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Rosa woodsii</i>			
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis/Juncus arcticus</i>	6.00		
<i>Agrostis stolonifera/Ranunculus cymbalaria</i>		8.00	14.00
<b>TOTAL COVER (Upland Species)</b>			26.00
<b>TOTAL COVER (Riparian Species)</b>			14.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			4.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>44.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q08C

**RIPARIAN COMPLEX DATA SHEET**

**July 2014**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: **Q09C**

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *July 15-17, 2014*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Changed to "early" due to flooding.*

APPARENT FORAGE TREND: *Now unstable*

ESTIMATED FORAGE PRODUCTION: *200 lbs/acre*

BEAVER ACTIVITY: *no*

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

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)
	<i>Artemisia tridentata</i>	<i>Trifolium sp.</i>	<i>Agrostis stolonifera</i>
	<i>Rosa woodsii</i>		<i>Juncus arcticus</i>
	<i>Salix boothii</i>		<i>Poa pratensis</i>

POOL ATTRIBUTES

% area in pools: *0*

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

AQUATIC VEGETATION

% streambed with filamentous algae: *0*

% stream margin with rooted aquatic: *0*

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *changed to 0*

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

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

BANK CONDITION

% bank length vegetated, stable: *45*

% bank length unvegetated, stable: *25*

% bank length vegetated, unstable: *5*

% bank length unvegetated, unstable: *25*

NOTES:

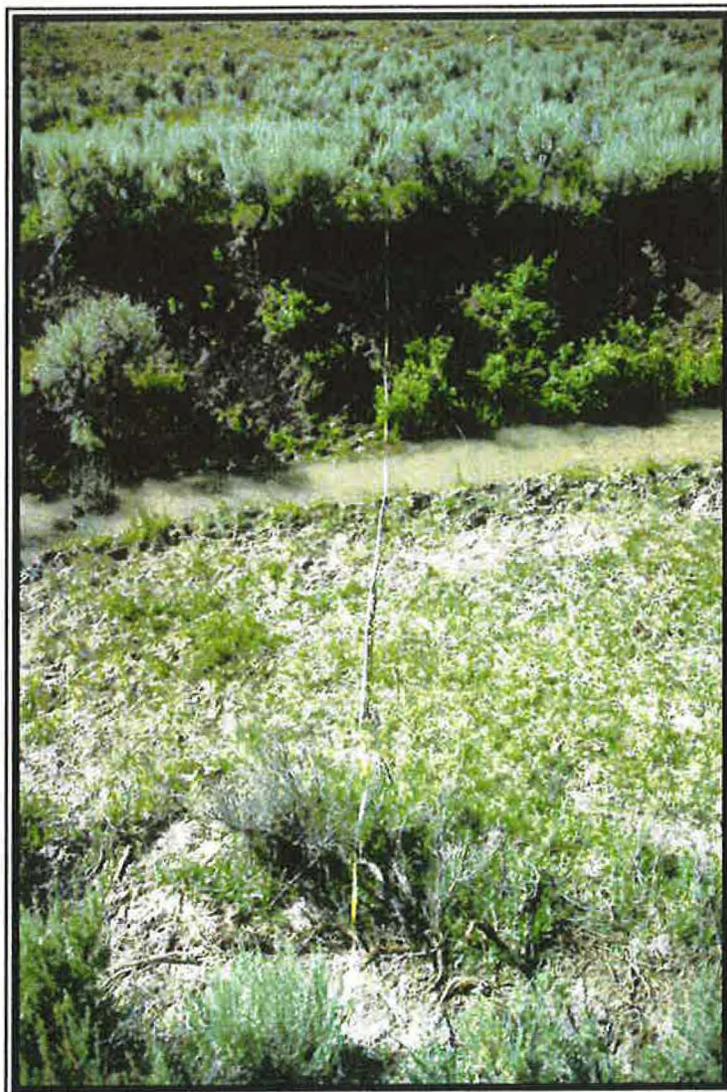
- 1) *This site was once more of a straightforward area to monitor the riparian zone.*
- 2) *This site is within the current planned subsidence zone.*
- 3) *The length of the transect line decreased by 2 ft, probably due to flooding mentioned in the 2013 notes. The channel was covered by a lot of sand, so it became less incised. This may have resulted in a decrease in the transect length. Also the right bank sloughed off possibly causing some decreased length too.*

## DATA SUMMARY

### Q09C: Cover by plant community types in the South Fork Quitchupah Creek drainage (July 2014).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>	9.00		
<i>Artemisia tridentata/Grasses</i>		8.00.00	
<i>Artemisia tridentata/Grasses</i>			17.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Rosa woodsii</i>		1.50	
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis/Juncus arcticus</i>	11.00		
<i>Equisetum arvensis/Poa pratensis</i>			
			12.50
<b>TOTAL COVER (Upland Species)</b>			17.00
<b>TOTAL COVER (Riparian Species)</b>			12.50
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			1.00
<b>BAREGROUND (channel)</b>			4.50
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>34.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q09C

**RIPARIAN COMPLEX DATA SHEET**  
**July 2014**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q105*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *July 15-17, 2014*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

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)
<i>Cornus sericea</i>		<i>Equisetum arvense</i>	
<i>Populus tremuloides</i>		<i>Viola adunca</i>	
<i>Pseudotsuga menziesii</i>			
<i>Rosa woodsii</i>			

POOL ATTRIBUTES

% area in pools: 25  
 % pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0  
 % bank length gently sloping (>135°): 75 (average)  
 % bank length with overhanging vegetation: 50 (conifers)

BANK CONDITION

	Left	Right
% bank length vegetated, stable:	10	25
% bank length unvegetated, stable:	70	75
% bank length vegetated, unstable:	0	0
% bank length unvegetated, unstable:	20	0

NOTES:

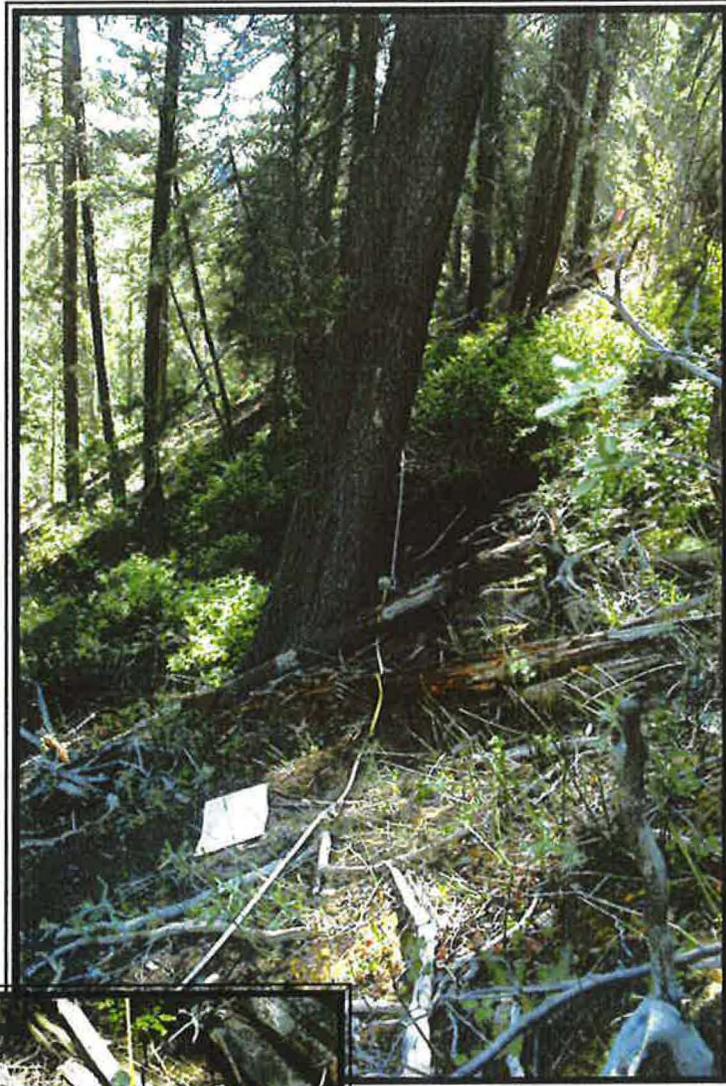
- 1) This site, also called Wedge Spring, is often measured for flow by a hydrologist.
- 2) It had rather low vegetative cover (see closeup photograph).
- 3) Water surfaced at a couple of locations.
- 4) The bottom-line is that there was not much riparian vegetation and it may be difficult to monitor.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

## DATA SUMMARY

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

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>	0.00		
<i>Conifer</i>		10.00	
<i>Conifer</i>			10.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Cornus sericea/Equisetum arvense</i>		15.00	
<u>Dominant Herbaceous Species</u>			
<i>Equisetum arvense</i>	33.00	19.00	
			67.00
<b>TOTAL COVER (Upland Species)</b>			10.00
<b>TOTAL COVER (Riparian Species)</b>			67.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			0.00
<b>BAREGROUND/MUD (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>77.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q10S (close up)

**RIPARIAN COMPLEX DATA SHEET**

**July 2014**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q11C*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *July 15-17, 2014*

OBSERVER(S): *P. Collins, G. McMillan*

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 but seemed more stable than last sample period.*

ESTIMATED FORAGE PRODUCTION: *600 lbs/acre*

BEAVER ACTIVITY: *Yes (upstream)*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *3 (more stable due to 2013 flood deposits)*

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)
<i>Abies concolor</i>	<i>Chrysothamnus nauseosus</i>	<i>Trifolium sp.</i>	<i>Agrostis stolonifera</i>
<i>Cornus sericea</i>			<i>Juncus arcticus</i>
<i>Populus tremuloides</i>			<i>Poa pratensis</i>
<i>Pseudotsuga menziesii</i>			
<i>Salix lutea?</i>			

POOL ATTRIBUTES

% area in pools: *50*  
 % pool area made up of pools > 2' deep: *0*

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*  
 % bank length gently sloping (>135°): *0*  
 % bank length with overhanging vegetation: *50*

BANK CONDITION

% bank length vegetated, stable: *75*  
 % bank length unvegetated, stable: *10*  
 % bank length vegetated, unstable: *5*  
 % bank length unvegetated, unstable: *10*

NOTES:

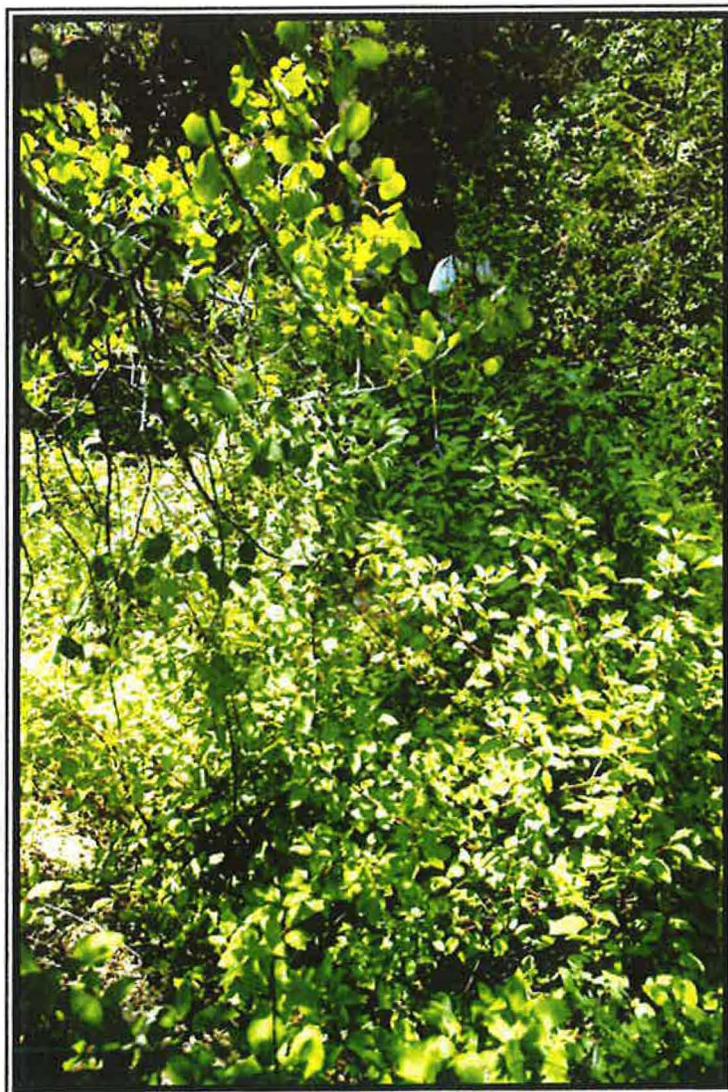
- 1) *2013 flooding seemed to have greatly impacted the riparian community here, but the dogwood recovered, is growing and regaining vigor.*
- 2) *This site was placed at water sampling station (called 006D).*

## DATA SUMMARY

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

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Populus tremuloides/Abies concolor</i>	0.00		
<i>Pseudotsuga menziesii</i>		3.00	3.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Cornus sericea</i>	12.00	3.00	15.00
<u>Dominant Herbaceous Species</u>			
<b>TOTAL COVER (Upland Species)</b>			3.00
<b>TOTAL COVER (Riparian Species)</b>			15.00
<b>ROCK (channel)</b>			6.00
<b>WATER (channel)</b>			6.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>30.00</b>

## PHOTOGRAPHIC DOCUMENTATION



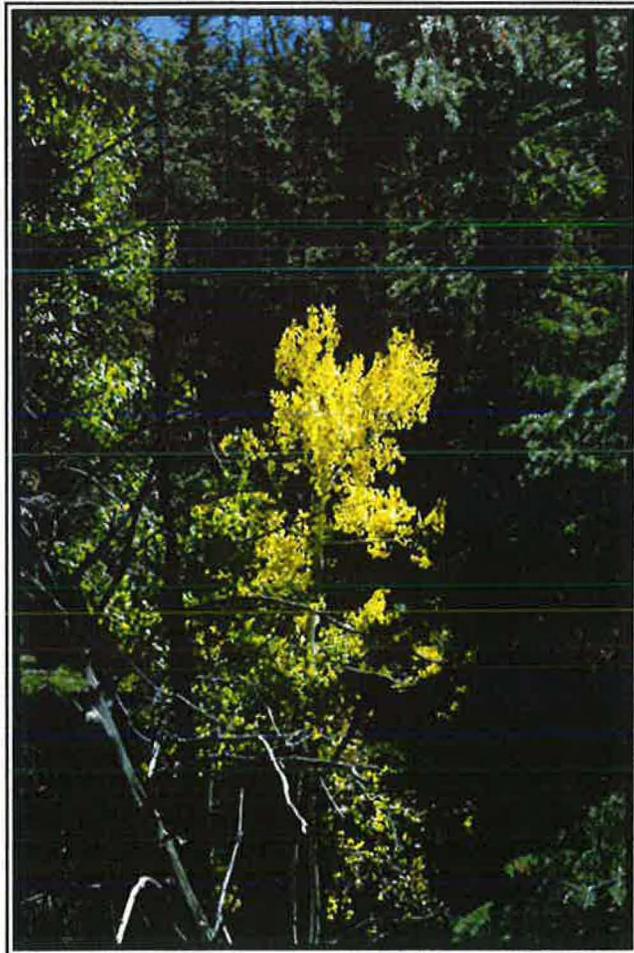
Q11C

# SECTION B

## RIPARIAN COMPLEX DATA SHEETS

for the

OCTOBER 2014  
SAMPLE PERIOD



RIPARIAN COMPLEX DATA SHEET

October 2014

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q01C*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 1-3, 2014*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

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

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

ESTIMATED FORAGE PRODUCTION: *300 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)
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Achillea millefolium</i>	<i>Carex nebrascensis</i>
<i>Salix boothii</i>	<i>Rosa woodsii</i>	<i>Taraxacum officinale</i>	<i>Juncus arcticus</i>
	<i>Symphoricarpos oreophilus</i>		<i>Poa pratensis</i>

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 (<90°): *0*  
 % bank length gently sloping (>135°): *0*  
 % bank length with overhanging vegetation: *10 (short Booth's willows)*

BANK CONDITION

% bank length vegetated, stable: *30*  
 % bank length unvegetated, stable: *20*  
 % bank length vegetated, unstable: *5*  
 % bank length unvegetated, unstable: *45*

NOTES:

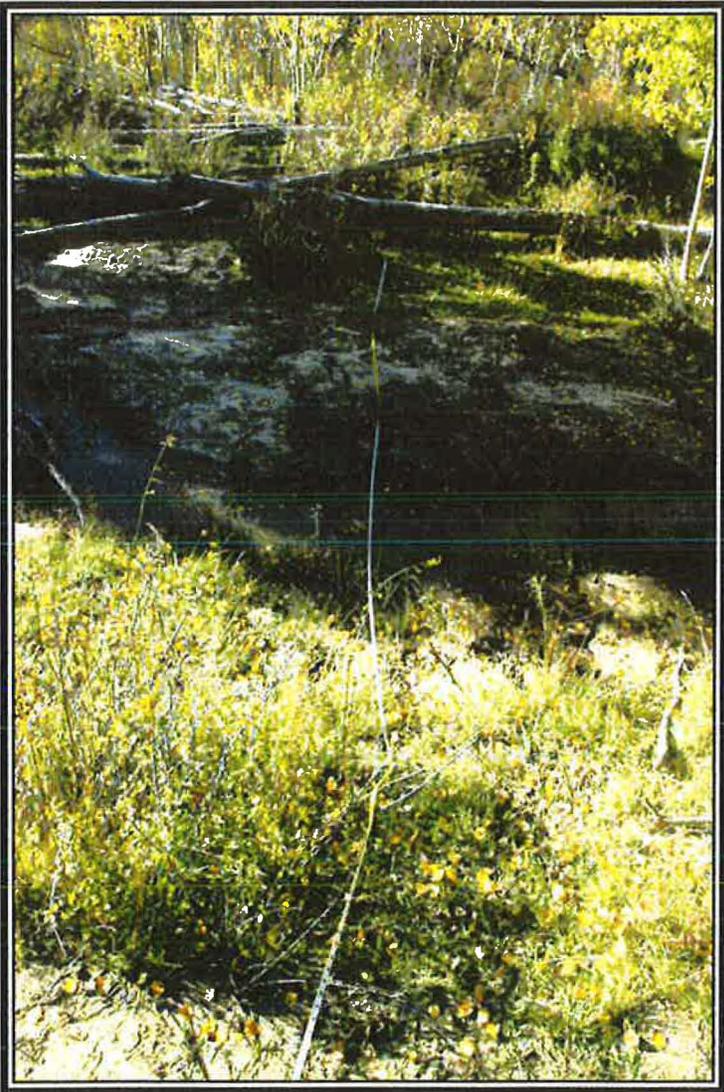
- 1) *This is a stream channel sample site.*
- 2) *This is a good creek channel monitoring site. It is outside the cattle trail and readily monitored.*
- 3) *Probably a good "control" site (outside the subsidence zone).*
- 4) *Cattle were present during this sample period.*
- 5) *All stakes were found.*
- 6) *There was evidence of a major flood here in 2013 (see October 2013 data). The riparian vegetation was greatly impacted by it. In October 2014, there was still a lot of sediments present that were deposited in that flood - and it has been raining hard here the past 2 days too.*

## DATA SUMMARY

### Q01C: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2014).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Symphoricarpos oreophilus/Artemisia tridentata/Poa pratensis</i>	10.00		
<i>Poa pratensis/Taraxacum officinale</i>		9.00	19.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Rosa woodsii</i>			
<u>Dominant Herbaceous Species</u>			
<i>Equisetum arvense</i>	3.00		
<i>Carex nebrascensis/Agrostis stolonifera</i>		4.00	7.00
<b>TOTAL COVER (Upland Species)</b>			19.00
<b>TOTAL COVER (Riparian Species)</b>			7.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			4.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>30.00</b>

PHOTOGRAPHIC DOCUMENTATION



Q01C

RIPARIAN COMPLEX DATA SHEET  
October 2014

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q025*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 1-3, 2014*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Mid*

APPARENT FORAGE TREND: *Decreasing (ground cover was mud and vegetation in the riparian area)*

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=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)
<i>Picea pungens</i>	<i>Ribes sp.</i>	<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Symphoricarpos oreophilus</i>	<i>Equisetum arvense</i>	<i>Carex nebrascensis</i>
		<i>Ranunculus cymbalaria</i>	<i>Poa pratensis</i>
		<i>Taraxacum officinale</i>	

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

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

BANK CONDITION

	<u>Center</u>	<u>Side</u>
% bank length vegetated, stable:	<i>0</i>	<i>65</i>
% bank length unvegetated, stable:	<i>50</i>	<i>15</i>
% bank length vegetated, unstable:	<i>0</i>	<i>5</i>
% bank length unvegetated, unstable:	<i>50</i>	<i>15</i>

NOTES:

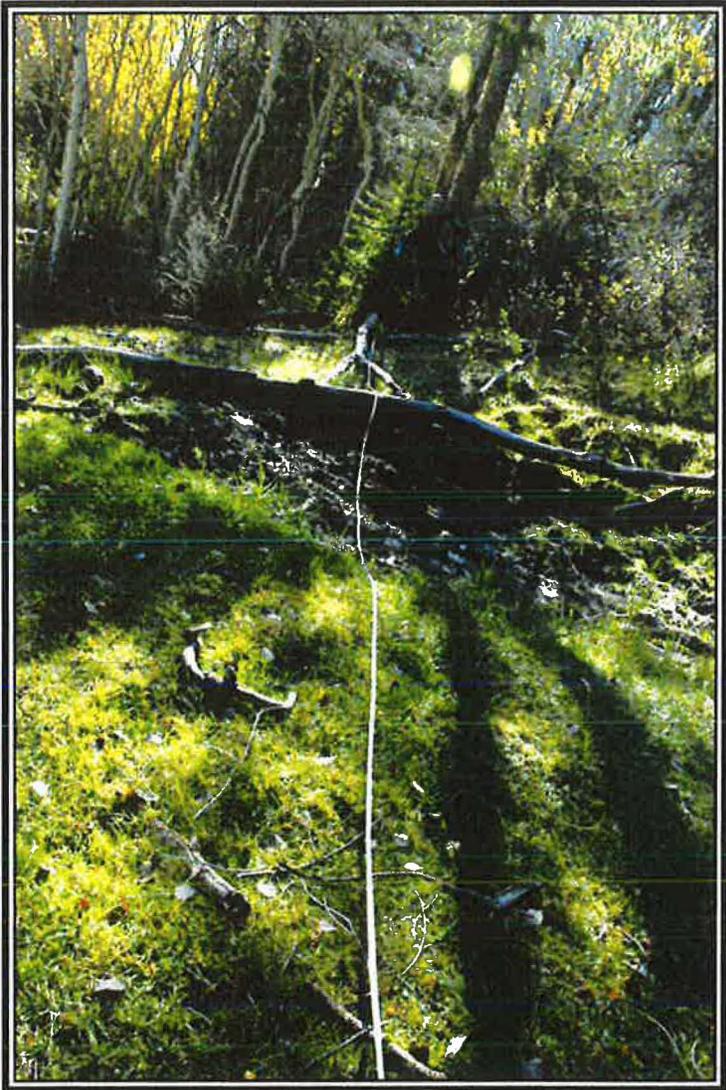
- 1) *This is a spring area.*
- 2) *Probably a good "control" site (outside the subsidence zone).*
- 3) *There were lots of cattle hoof-prints (disturbance).*
- 4) *All stakes were located.*
- 4) *The Bank Condition represents both the bank and wet areas (refer to the photograph).*
- 5) *Lots of cattle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

## DATA SUMMARY

### Q02S: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2014).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Poa pratensis</i> / <i>Achillea millefolium</i>	10.00		
<i>Geranium richardsonii</i> / <i>Poa pratensis</i>		7.00	17.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Ranunculus cymbalaria</i> / <i>Agrostis stolonifera</i>		6.00	
<i>Carex nebrascensis</i> / <i>Agrostis stolonifera</i>	1.00		7.00
<b>TOTAL COVER (Upland Species)</b>			17.00
<b>TOTAL COVER (Riparian Species)</b>			7.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			3.00
<b>BAREGROUND (channel)</b>			5.00
<b>LITTER (channel)</b>			1.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>33.00</b>

PHOTOGRAPHIC DOCUMENTATION



Q02S

**RIPARIAN COMPLEX DATA SHEET**  
**October 2014**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: **Q03C**

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 1-3, 2014*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

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): *3-4 (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)
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Aster sp.</i>	<i>Agrostis stolonifera</i>
	<i>Rosa woodsii</i>	<i>Equisetum arvense</i>	<i>Juncus arcticus</i>
	<i>Salix spp.</i>	<i>Taraxacum officinale</i>	

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0 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: *70*  
 % bank length unvegetated, unstable: *65*

NOTES:

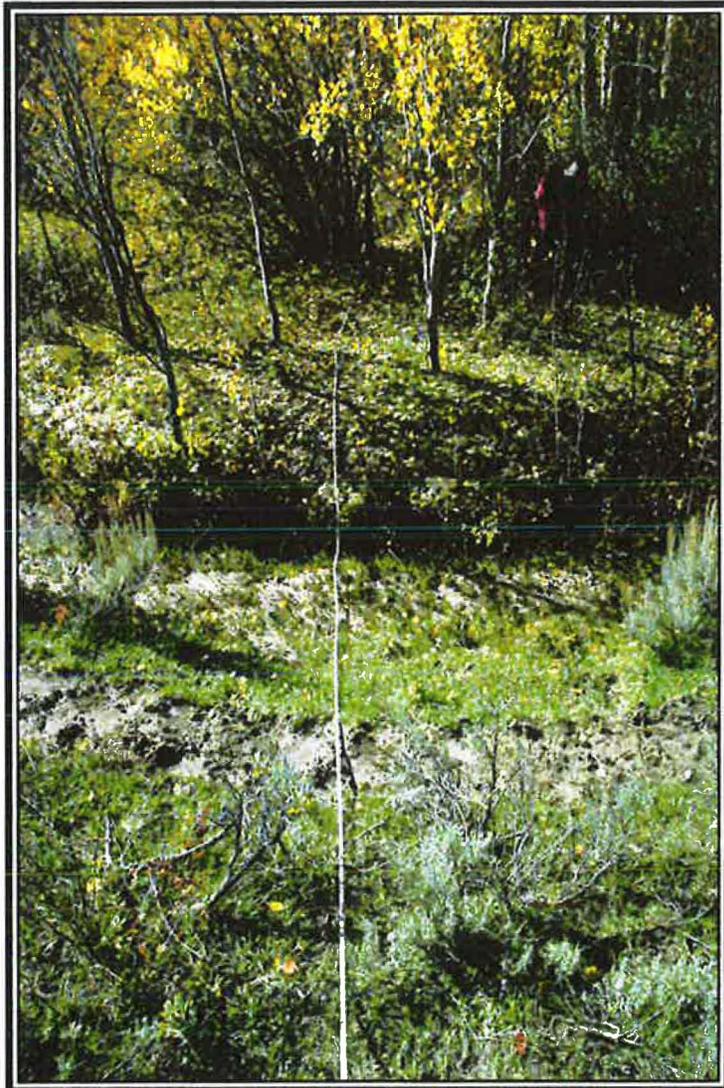
- 1) *This is a channel site.*
- 2) *A good control station; outside current subsidence plans.*
- 3) *It seems like we needed a sample here, but this may be more difficult to monitor as accurately due to the topography. The narrow channel sites are more straight-forward to monitor than this type.*
- 4) *Interestingly, the adjacent aspen understory (that I considered upland) continues to have 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 in 2013 (see 2013 data and notes). 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 2014).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Artemisia tridentata/Elymus salinus</i>	10.00		
<i>Populus tremuloides/Juncus arcticus</i>		15.00	25.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Equisetum arvense</i>	4.00		
<i>Agrostis stolonifera</i>	4.00	1.00	9.00
<b>TOTAL COVER (Upland Species)</b>			25.00
<b>TOTAL COVER (Riparian Species)</b>			9.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			2.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>36.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q03C

**RIPARIAN COMPLEX DATA SHEET**  
**October 2014**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q045*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 1-3, 2014*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Late*

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *900 lbs/acre*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *2 (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)
<i>Picea pungens</i>	<i>Rosa woodsii</i>	<i>Achillea millefolium</i>	<i>Eleocharis palustris</i>
<i>Populus tremuloides</i>	<i>Salix boothii</i>	<i>Equisetum arvense</i>	<i>Hordeum jubatum</i>
		<i>Geranium richardsonii</i>	<i>Juncus arcticus</i>
			<i>Juncus longistylis</i>
			<i>Poa pratensis</i>

POOL ATTRIBUTES

% area in pools: *100*

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

AQUATIC VEGETATION

% streambed with filamentous algae: *0*

% stream margin with rooted aquatic: *0*

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*

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

% bank length with overhanging vegetation: *50*

BANK CONDITION

% bank length vegetated, stable: *60*

% bank length unvegetated, stable: *0*

% bank length vegetated, unstable: *10*

% 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 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) *The riparian vegetation had filled in since October 2013.*
- 6) *The water "cover" was about 30%.*

## DATA SUMMARY

### Q04S: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2014).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Symphoricarpos oreophilus/Populus tremuloides</i>	9.00		
		6.00	
			15.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Ranunculus cymbalaria/Carex nebrascensis</i>	4.00	3.00	
<i>Agrostis stolonifera/Ranunculus cymbalaria/Carex nebrascensis</i>	3.00	4.00	
<i>Carex nebrascensis/Agrostis stolonifera</i>	13.00	14.00	
			41.00
<b>TOTAL COVER (Upland Species)</b>			15.00
<b>TOTAL COVER (Riparian Species)</b>			41.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			9.00
<b>BAREGROUND (channel)</b>			8.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>56.00</b>

PHOTOGRAPHIC DOCUMENTATION



Q04S

**RIPARIAN COMPLEX DATA SHEET**  
**October 2014**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: **Q055**

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 1-3, 2014*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Late*

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

ESTIMATED FORAGE PRODUCTION: *700 lbs/acre*

BEAVER ACTIVITY: *Yes, just upstream*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *3 (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)
<i>Abies concolor</i>	<i>Salix boothii</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
<i>Picea pungens</i>	<i>Symphoricarpos oreophilus</i>	<i>Geranium richardsonii</i>	<i>Carex nebrascensis</i>
<i>Pinus flexilis</i>		<i>Ranunculus cymbalaria</i>	
<i>Populus tremuloides</i>			

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*  
 % bank length gently sloping (>135°): *100*  
 % bank length with overhanging vegetation: *20*

BANK CONDITION

% bank length vegetated, stable: *60*  
 % bank length unvegetated, stable: *5*  
 % bank length vegetated, unstable: *5*  
 % bank length unvegetated, unstable: *30*

NOTES:

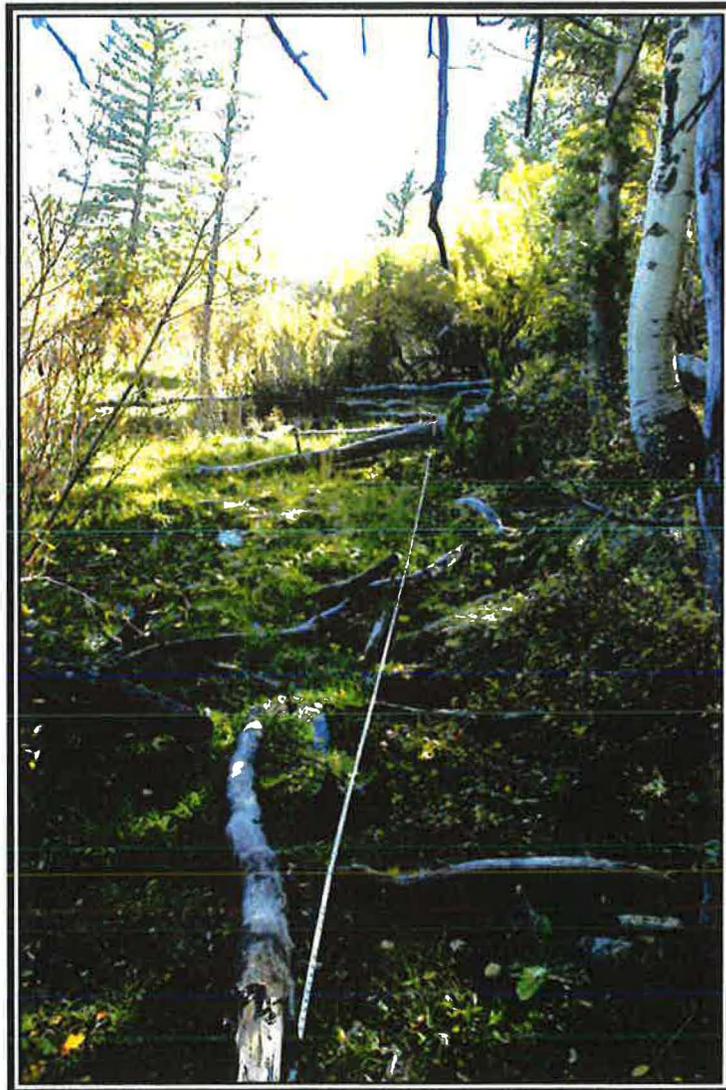
- 1) *This is a well-defined spring area.*
- 2) *A good control station; it is just outside current subsidence plans.*
- 3) *When I placed the transect tape, it formed a "U" shape to measure. This tape was placed 4 ft from the upland bank for 73 ft of riparian/spring vegetation.*
- 4) *For this sample period, the water area comprised about 35% of the 73 ft mentioned above.*
- 5) *There was less impact from cattle trampling at the site when compared to last year (2013).*
- 6) *There was more vegetation and water compared to 2013, when July had no water, but in October water was present.*
- 7) *In October 2014, there was about 35% water cover and 65% vegetation. It looked better this year.*

## DATA SUMMARY

### Q05S: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2014).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Salix boothii/Picea pungens</i>	11.00		
<i>Picea pungens/Populus tremuloides</i>		9.00	
			20.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis/Agrostis stolonifera/Ranunculus cymbalaria</i>	36.50	36.50	
			73.00
<b>TOTAL COVER (Upland Species)</b>			20.00
<b>TOTAL COVER (Riparian Species)</b>			73.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			0.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>93.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q05S

**RIPARIAN COMPLEX DATA SHEET**  
**October 2014**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q065*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 1-3, 2014*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Late*

APPARENT FORAGE TREND: *Only semi-stable due to cattle impacts*

ESTIMATED FORAGE PRODUCTION: *600 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)
<i>Populus tremuloides</i>	<i>Ribes sp</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
	<i>Salix boothii</i>	<i>Taraxacum officinale</i>	<i>Poa pratensis</i>

POOL ATTRIBUTES

% area in pools: *0 (no water at the transect line but it was muddy; there was water in hoof-prints just up from the transect).*

% 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:

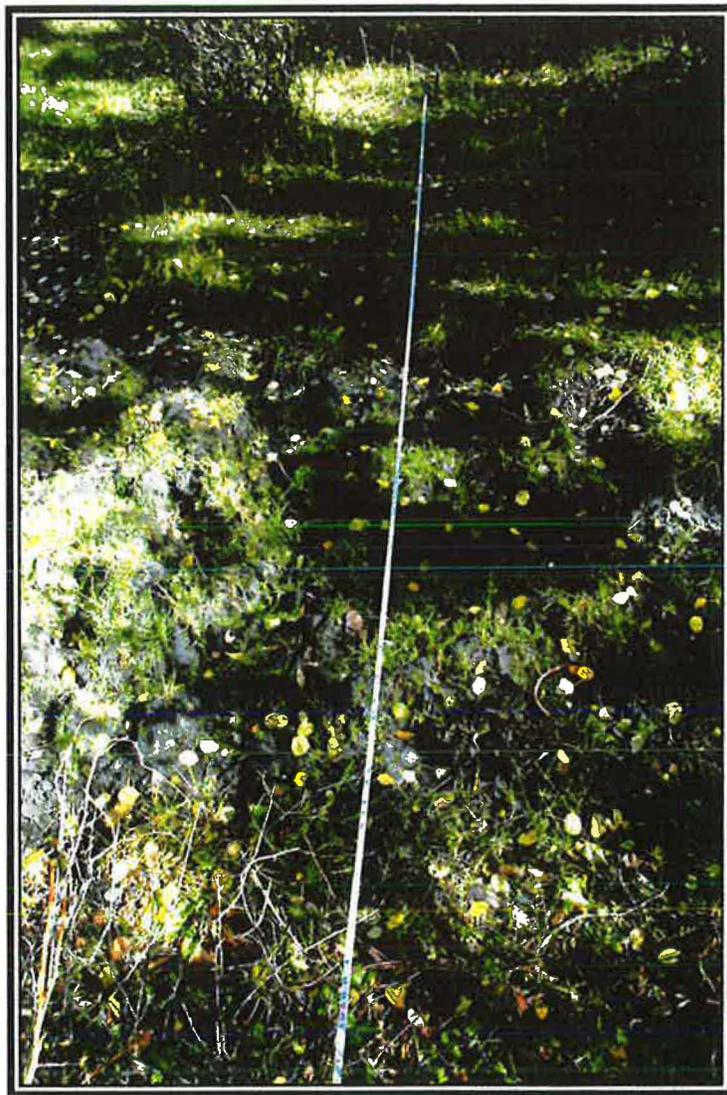
- 1) *Only measured obvious, well-defined spring area.*
- 2) *Left side measured to bank (3 ft).*
- 3) *Cattle had an impact for this sample period. Therefore, the riparian vegetation was almost all located on the side of the spring channel.*
- 4) *Riparian/wetland vegetation was measured in the spring 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 2014).

<b>USDA Forest Service Protocol (1992)</b>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Populus tremuloides/Salix boothii</i> <i>Symphoricarpos oreophilus/Grasses</i>	9.00	3.00	12.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Agrostis stolonifera</i>	4.00	4.00	8.00
<b>TOTAL COVER (Upland Species)</b>			12.00
<b>TOTAL COVER (Riparian Species)</b>			8.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			0.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>20.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q06S

RIPARIAN COMPLEX DATA SHEET

October 2014

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q07C*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 1-3, 2014*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Late*

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)
	<i>Rosa woodsii</i>	<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
	<i>Salix boothii</i>	<i>Trifolium sp.</i>	<i>Carex nebrascensis</i>
			<i>Hordeum jubatum</i>
			<i>Poa pratensis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *100 now due 2013 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 earliest sample periods. Now 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 in 2013. The flood impacts were more depositional than erosional.*

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

## DATA SUMMARY

### Q07C: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2014).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>	0.00		
<i>Poa pratensis/Achillea millefolium</i>		0.00	
<i>Poa pratensis/Achillea millefolium</i>			0.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Rosa woodsii</i>	7.00		
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis/Agrostis stolonifera</i>	23.00	24.00	
			54.00
<b>TOTAL COVER (Upland Species)</b>			0.00
<b>TOTAL COVER (Riparian Species)</b>			54.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			1.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>55.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q07C

**RIPARIAN COMPLEX DATA SHEET**  
**October 2014**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: **Q08C**

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 1-3, 2014*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Early due to flooding*

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *600 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)
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Trifolium sp.</i>	<i>Agrostis stolonifera</i>
	<i>Salix boothii</i>		<i>Carex nebrascensis</i>
			<i>Juncus arcticus</i>

POOL ATTRIBUTES

% area in pools: *25*  
 % pool area made up of pools > 2' deep: *0*

AQUATIC VEGETATION

% streambed with filamentous algae: *0*  
 % stream margin with rooted aquatic: *50 (Cane on left side only)*

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*  
 % bank length gently sloping (>135°): *100 but above the incised (6") 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:

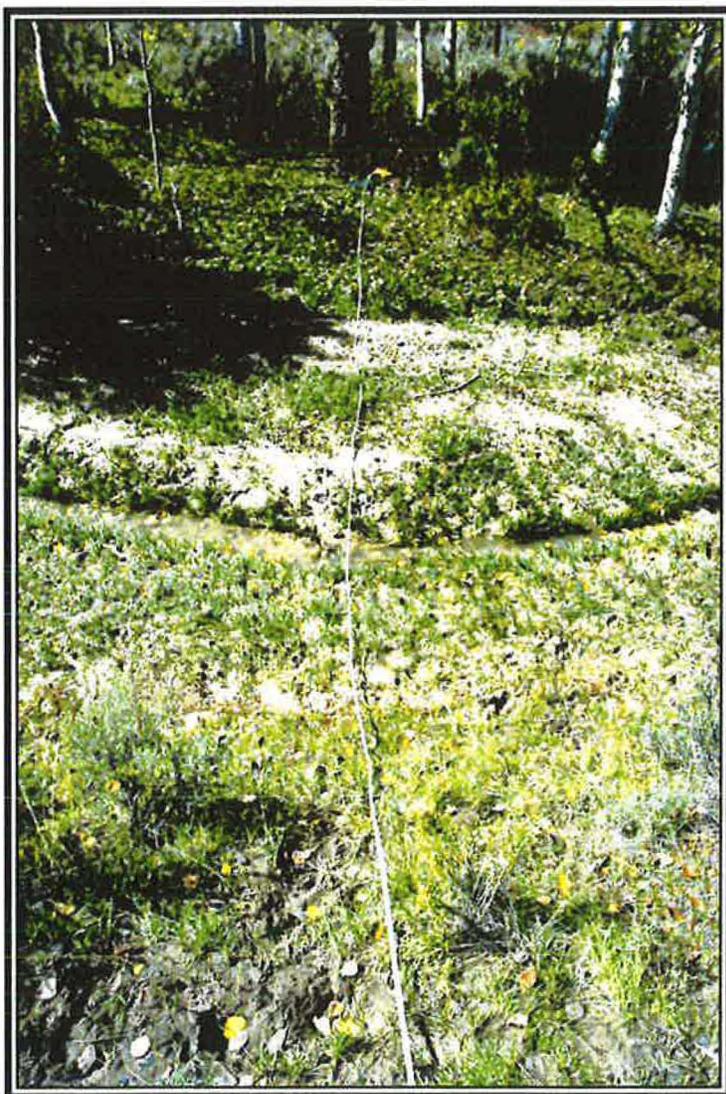
- 1) *This site had a straightforward area to monitor the riparian zone. The station went from low water to a low terrace, then a high terrace and finally to the aspen forest.*
- 2) *This site is within the current planned subsidence zone.*
- 3) *There was evidence of a major flood here (see 2013 data. 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.*
- 4) *Cattle grazing seemed to prefer Nebraska sedge.*

## DATA SUMMARY

### Q08C: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2014).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Artemisia tridentata/Grasses</i>	10.00		
<i>Populus tremuloides/Symphoricarpos oreophilus</i>		16.00	
			26.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Rosa woodsii</i>			
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis</i>	4.50	2.00	
<i>Agrostis stolonifera</i>	3.00	7.00	
			16.50
<b>TOTAL COVER (Upland Species)</b>			26.00
<b>TOTAL COVER (Riparian Species)</b>			16.50
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			1.50
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>44.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q08C

RIPARIAN COMPLEX DATA SHEET

October 2014

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q09C*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 1-3, 2014*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Early due to floods*

APPARENT FORAGE TREND: *Unstable*

ESTIMATED FORAGE PRODUCTION: *<100 lbs/acre (less now due to 2013 floods)*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *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)
	<i>Artemisia tridentata</i>	<i>Trifolium sp.</i>	<i>Agrostis stolonifera</i>
	<i>Rosa woodsii</i>		<i>Juncus arcticus</i>
	<i>Salix boothii</i>		<i>Poa pratensis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): *Previously 100 on both sides of the channel, but the flooding filled them in.*
- % bank length gently sloping (>135°): *100 but above the incised channel.*
- % bank length with overhanging vegetation: *(herbaceous only)*

BANK CONDITION

- % bank length vegetated, stable: *10*
- % bank length unvegetated, stable: *40*
- % bank length vegetated, unstable: *5*
- % bank length unvegetated, unstable: *45*

NOTES:

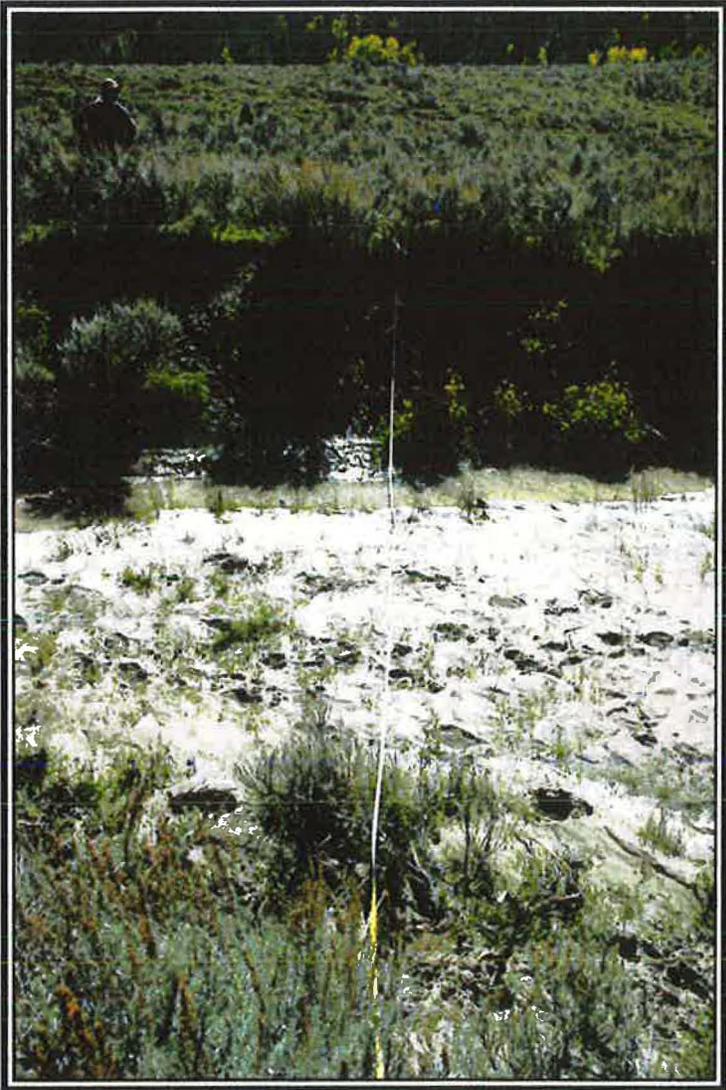
- 1) *This site is a straightforward area to monitor the riparian zone.*
- 2) *This site is within the current planned subsidence zone.*
- 3) *Keep in mind that the transect vegetation width may be consistent, but the total living cover may have decreased within the transect zone due to flooding & deposition. This area was a good example of that. For example, the left side had 13ft of riparian vegetation, but its total living cover was only about 5% because so much sediment was deposited there.*
- 4) *The deposition may also render the area somewhat dryer.*
- 5) *See also July 2014 notes.*
- 6) *The right side had sloughed off so much it was about 1 ft from the wooden stake.*
- 7) *Right side was Wood's rose, so I called it riparian.*

## DATA SUMMARY

### Q09C: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2014).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>	8.00		
<i>Artemisia tridentata/Grasses</i>		1.00	
<i>Artemisia tridentata/Grasses</i>			9.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Rosa woodsii</i>		9.00	
<u>Dominant Herbaceous Species</u>			
<i>Equisetum arvense</i>	13.00		
			22.00
<b>TOTAL COVER (Upland Species)</b>			9.00
<b>TOTAL COVER (Riparian Species)</b>			22.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			3.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>34.00</b>

PHOTOGRAPHIC DOCUMENTATION



Q09C

**RIPARIAN COMPLEX DATA SHEET**  
**October 2014**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q105*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 1-3, 2014*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

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): *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)
<i>Cornus sericea</i>		<i>Equisetum arvense</i>	
<i>Populus tremuloides</i>		<i>Viola adunca</i>	
<i>Pseudotsuga menziesii</i>			
<i>Rosa woodsii</i>			

POOL ATTRIBUTES

% area in pools: 35  
 % pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

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

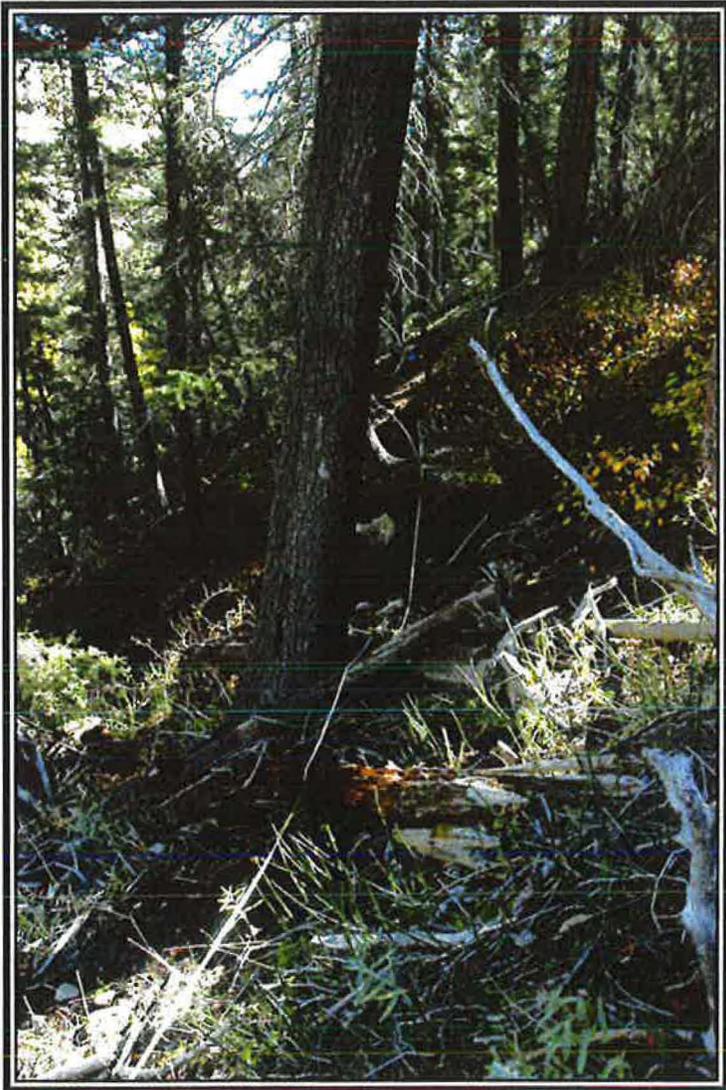
- 1) This site, also called Wedge Spring, is often measured for flow by a hydrologist.
- 2) It had rather low vegetative cover.
- 3) Water surfaced at several locations here probably do to the recent precipitation.
- 4) The bottom-line is that there was not much riparian vegetation and it may be difficult 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) There was low living cover here most of which was horsetail.

## DATA SUMMARY

### Q10S: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2014).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>	0.00		
<i>Conifer</i>		10.00	
<i>Conifer</i>			10.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Cornus sericea</i>	12.00		
<u>Dominant Herbaceous Species</u>			
<i>Equisetum arvense</i>	27.00	28.00	
			67.00
<b>TOTAL COVER (Upland Species)</b>			10.00
<b>TOTAL COVER (Riparian Species)</b>			67.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			0.00
<b>BAREGROUND/MUD (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>77.00</b>

PHOTOGRAPHIC DOCUMENTATION



Q10C

**RIPARIAN COMPLEX DATA SHEET**  
**October 2014**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: **Q11C**

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 1-3, 2014*

OBSERVER(S): *P. Collins, G. McMillan*

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 at site and 2 new beaver dams were built upstream ~  
0.25 mi.*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *4 (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)
<i>Abies concolor</i>	<i>Chrysothamnus nauseosus</i>	<i>Trifolium sp.</i>	<i>Agrostis stolonifera</i>
<i>Cornus sericea</i>			<i>Juncus arcticus</i>
<i>Populus tremuloides</i>			<i>Poa pratensis</i>
<i>Pseudotsuga menziesii</i>			
<i>Salix lutea?</i>			

POOL ATTRIBUTES

% area in pools: *50 (upstream large big pool). Transect area was 10% pools; general area was 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

	<u>Left</u>	<u>Right</u>
% bank length vegetated, stable:	<i>50</i>	<i>30</i>
% bank length unvegetated, stable:	<i>15</i>	<i>30</i>
% bank length vegetated, unstable:	<i>20</i>	<i>10</i>
% bank length unvegetated, unstable:	<i>15</i>	<i>30</i>

NOTES:

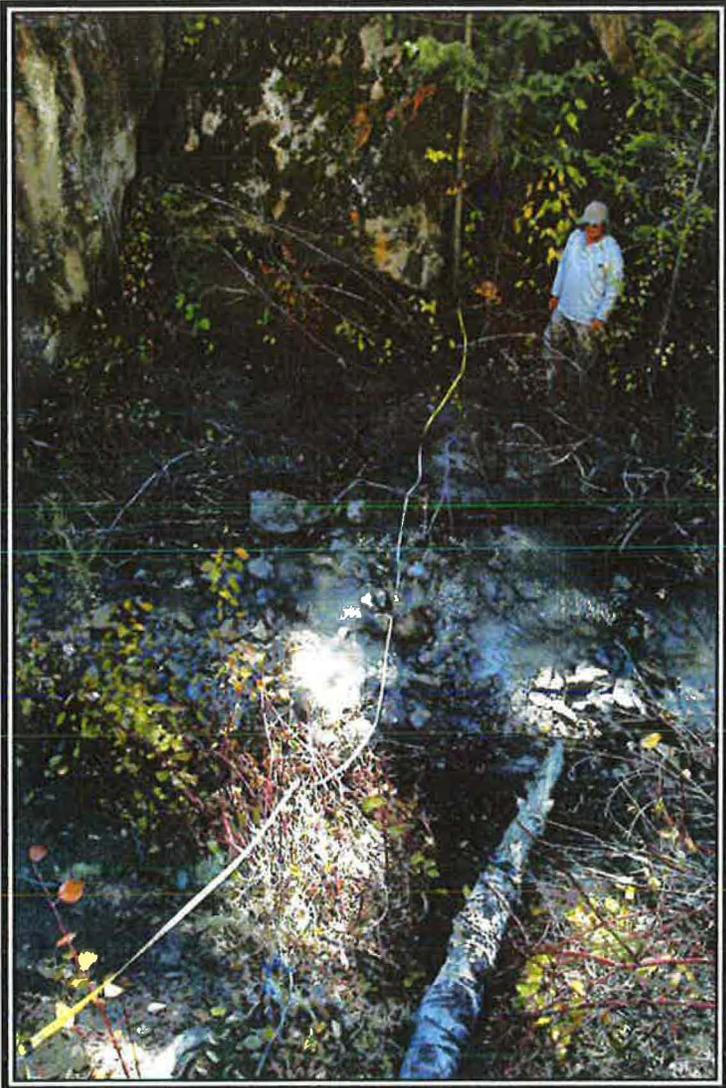
- 1) *The plant cover was dogwood.*
- 2) *Recent flooding appears to have greatly impacted the riparian community here.*
- 3) *This site was placed at water sampling station (called 006D).*

## DATA SUMMARY

### Q11C: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2014).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Populus tremuloides/Abies concolor</i>	0.00		
<i>Pseudotsuga menziesii</i>		3.00	
			3.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Cornus sericea</i>	13.00	4.00	
<u>Dominant Herbaceous Species</u>			
			17.00
<b>TOTAL COVER (Upland Species)</b>			3.00
<b>TOTAL COVER (Riparian Species)</b>			17.00
<b>ROCK (channel)</b>			5.00
<b>WATER (channel)</b>			5.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>30.00</b>

PHOTOGRAPHIC DOCUMENTATION



Q11C

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

July & October

2015

**FOR THE  
SUFCO MINE  
SEVIER COUNTY, UTAH**



*Prepared by*

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February 2016



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# Introduction

The SUFCO Coal Mine expanded their underground operations adjacent to and below some reaches of the South Fork Quitchupah Creek. Prior to mining and since that time, 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 have been conducted before, during, and after the mining activities in the area. This document includes the results of quantitative and qualitative vegetation sampling in several locations within and outside the subsidence zones. Similar to 2013 and 2014, the results herein include two sample periods in 2015 – July and October.

## 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.

## Scope of Study

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

Quitichupah 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 Quitichupah 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

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:	

perpendicular to) the stream channel. By design, the line transects vary in lengths which are based on several factors. Although sometimes limited by 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*. Finally, each sample site was numbered sequentially and by the hydrologic type. For example, **Q01C** refers to the creek name (Quitcupah), 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.



# SECTION A

## RIPARIAN COMPLEX DATA SHEETS

for the

JULY 2015  
SAMPLE PERIOD



Elkweed (*Swertia radiata*)

**RIPARIAN COMPLEX DATA SHEET**  
**July 2015**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q07C*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *July 7-9, 2015*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

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=slight; 5=extreme): *2*

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)
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
<i>Salix boothii</i>	<i>Rosa woodsii</i>	<i>Taraxacum officinale</i>	<i>Carex nebrascensis</i>
	<i>Symphoricarpos oreophilus</i>		<i>Juncus arcticus</i>
			<i>Poa pratensis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

% streambed with filamentous algae: *0*  
 % stream margin with rooted aquatic: *25*

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*  
 % bank length gently sloping (>135°): *50 (right side)*  
 % bank length with overhanging vegetation: *25 (short Booth's willows)*

BANK CONDITION

% bank length vegetated, stable: *85*  
 % bank length unvegetated, stable: *10*  
 % bank length vegetated, unstable: *0*  
 % bank length unvegetated, unstable: *5*

NOTES:

- 1) *This is a good creek channel monitoring site. It is outside the cattle trail and can be readily monitored.*
- 2) *Probably a good "control" site (outside the subsidence zone).*
- 3) *Fewer cattle impacts compared to July 2014; site looks good.*

## DATA SUMMARY

### Q01C: Cover by plant community types in the South Fork Quitchupah Creek drainage (July 2015).

<b>USDA Forest Service Protocol (1992)</b>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Symphoricarpos oreophilus/Artemisia tridentata/Poa pratensis</i>	9.00		
<i>Poa pratensis/Taraxacum officinale</i>		9.00	10.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant woody Species</u>			
<i>Salix boothii</i>			
<u>Dominant Herbaceous Species</u>			
<i>Juncus arcticus</i>	4.00	6.00	10.00
<b>TOTAL COVER (Upland Species)</b>			18.00
<b>TOTAL COVER (Riparian Species)</b>			10.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			2.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			30.00

## PHOTOGRAPHIC DOCUMENTATION



Q01C

**RIPARIAN COMPLEX DATA SHEET**

**July 2015**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q025*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *July 7-9, 2015*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Mid*

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

ESTIMATED FORAGE PRODUCTION: *100 lbs/acre in spring; 800 at adjacent vegetation.*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *Inside of spring =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)
<i>Picea pungens</i>	<i>Ribes sp.</i>	<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Symphoricarpos oreophilus</i>	<i>Equisetum arvense</i>	<i>Carex nebrascensis</i>
		<i>Ranunculus cymbalaria</i>	<i>Poa pratensis</i>
		<i>Taraxacum officinale</i>	

POOL ATTRIBUTES

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

AQUATIC VEGETATION

% streambed with filamentous algae: *0*  
 % stream margin with rooted aquatic: *20% in spring*

BANK TYPE & VEGETATION OVERHANG

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

BANK CONDITION

	<u>Center</u>	<u>Side</u>
% bank length vegetated, stable:	<i>20</i>	<i>85</i>
% bank length unvegetated, stable:	<i>20</i>	<i>5</i>
% bank length vegetated, unstable:	<i>30</i>	<i>10</i>
% bank length unvegetated, unstable:	<i>30</i>	<i>0</i>

NOTES:

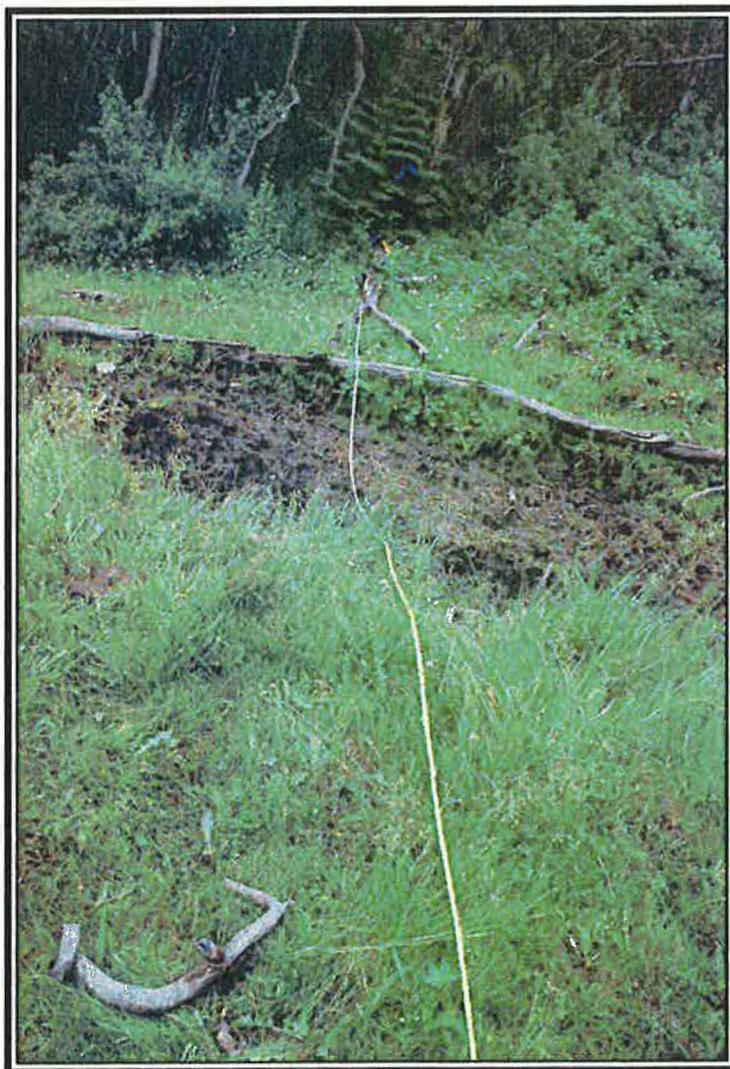
- 1) *This is a spring area*
- 2) *Probably a good "control" site (outside the subsidence zone)*
- 3) *There were lots of cattle hoof-prints (disturbance)*
- 4) *The Bank Condition represents both the bank and wet areas (refer to the photograph)*
- 5) *The center of the spring was comprised of mostly mud with some water*
- 6) *The spring had little riparian vegetation except for its perimeter that had some riparian plant cover*

## DATA SUMMARY

### Q02S: Cover by plant community types in the South Fork Quitchupah Creek drainage (July 2015).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Poa pratensis</i> / <i>Achillea millefolium</i> <i>Geranium richardsonii</i> / <i>Poa pratensis</i>	10.00	10.00	20.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Agrostis stolonifera</i> <i>Carex nebrascensis</i>	3.00	4.00 1.00	8.00
<b>TOTAL COVER (Upland Species)</b>			20.00
<b>TOTAL COVER (Riparian Species)</b>			8.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			2.00
<b>BAREGROUND (channel)</b>			3.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>33.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q02S

**RIPARIAN COMPLEX DATA SHEET**  
**July 2015**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q03C*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *July 7-9, 2015*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

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

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): *2 (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)
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Aster sp.</i>	<i>Agrostis stolonifera</i>
	<i>Rosa woodsii</i>	<i>Equisetum arvense</i>	<i>Juncus arcticus</i>
	<i>Salix spp.</i>	<i>Taraxacum officinale</i>	<i>Juncus longistylis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

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

BANK CONDITION

% bank length vegetated, stable: *90*  
 % bank length unvegetated, stable: *70*  
 % bank length vegetated, unstable: *0*  
 % bank length unvegetated, unstable: *0*

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, so we called the upper level upland.*

## DATA SUMMARY

### Q03C: Cover by plant community types in the South Fork Quitchupah Creek drainage (July 2015).

<b>USDA Forest Service Protocol (1992)</b>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Artemisia tridentata/Elymus salinus</i>	10.00		
<i>Populus tremuloides/Juncus arcticus</i>		14.00	
			24.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Agrostis stolonifera</i>	3.00		
<i>Equisetum arvense</i>	4.00	2.00	
			9.00
<b>TOTAL COVER (Upland Species)</b>			24.00
<b>TOTAL COVER (Riparian Species)</b>			9.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			2.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>35.00</b>

### PHOTOGRAPHIC DOCUMENTATION



Q03C

**RIPARIAN COMPLEX DATA SHEET**  
**July 2015**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q045*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *July 7-9, 2015*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Less cattle impact this July.*

APPARENT FORAGE TREND: *Stable this sample period*

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

BEAVER ACTIVITY: *Beaver chewing on tree from the past*

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

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)
<i>Picea pungens</i>	<i>Rosa woodsii</i>	<i>Achillea millefolium</i>	<i>Eleocharis palustris</i>
<i>Populus tremuloides</i>	<i>Salix boothii</i>	<i>Equisetum arvense</i>	<i>Hordeum jubatum</i>
		<i>Geranium richardsonii</i>	<i>Juncus arcticus</i>
			<i>Juncus longistylis</i>
			<i>Poa pratensis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*  
 % bank length gently sloping (>135°): *100*  
 % bank length with overhanging vegetation: *50*

BANK CONDITION

Spring/mud area

% bank length vegetated, stable: *85*  
 % bank length unvegetated, stable: *5*  
 % bank length vegetated, unstable: *0*  
 % bank length unvegetated, unstable: *5*

NOTES:

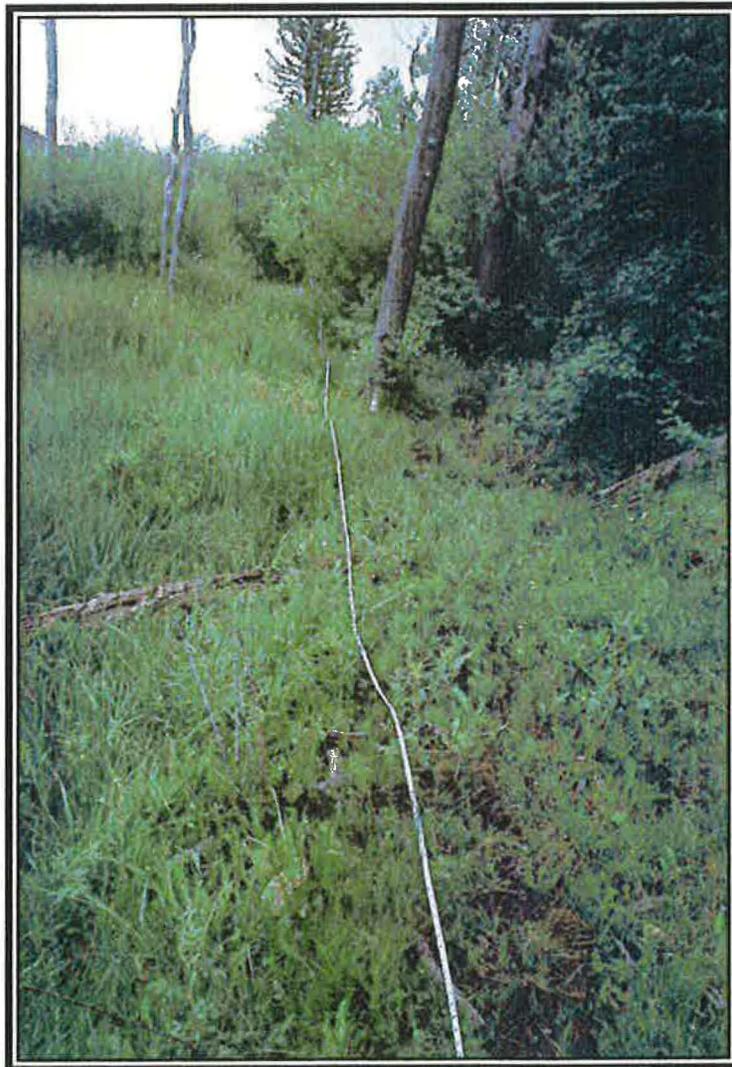
- 1) *This is a spring area.*
- 2) *It is a good control station; outside current subsidence plans.*
- 3) *The spring was mostly dry in July 2013. In July 2014, in the spring area, there was 50% water, 50% mud; 90% water and 10% mud in July 2015.*
- 4) *The spring site had several zones of vegetation based on the different water regimes.*
- 5) *Nebraska sedge dominated the wettest areas. Left side riparian vegetation changed to wiregrass.*
- 6) *In July 2015, there was less impact from cattle trampling here compared to July 2014 probably resulting in higher total living cover.*

## DATA SUMMARY

### Q04S: Cover by plant community types in the South Fork Quitchupah Creek drainage (July 2015).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Symphoricarpos oreophilus/Populus tremuloides</i>	0.00		
<i>Picea pungens/Salix boothii</i>		9.00	
			9.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Juncus arcticus</i>	10.00		
<i>Carex nebrascensis/Agrostis stolonifera</i>		37.00	
			47.00
<b>TOTAL COVER (Upland Species)</b>			9.00
<b>TOTAL COVER (Riparian Species)</b>			47.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			0.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MUD (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>56.00</b>

PHOTOGRAPHIC DOCUMENTATION



Q04S

**RIPARIAN COMPLEX DATA SHEET**  
**July 2015**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q055*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *July 7-9, 2015*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Late*

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *1,050 lbs/acre*

BEAVER ACTIVITY: *There was some beaver activity close by.*

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

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)
<i>Picea pungens</i>	<i>Salix boothii</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
<i>Pinus flexilis</i>	<i>Symphoricarpos oreophilus</i>	<i>Geranium richardsonii</i>	<i>Carex nebrascensis</i>
<i>Populus tremuloides</i>		<i>Ranunculus cymbalaria</i>	

#### POOL ATTRIBUTES

% area in pools: *100 (in hoof-prints)*

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

#### AQUATIC VEGETATION

% streambed with filamentous algae: *0*

% stream margin with rooted aquatic: *100% in the spring*

#### BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*

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

% bank length with overhanging vegetation: *20*

#### BANK CONDITION (in spring/riparian area)

% bank length vegetated, stable: *70*

% bank length unvegetated, stable: *10*

% bank length vegetated, unstable: *15*

% bank length unvegetated, unstable: *5*

#### NOTES:

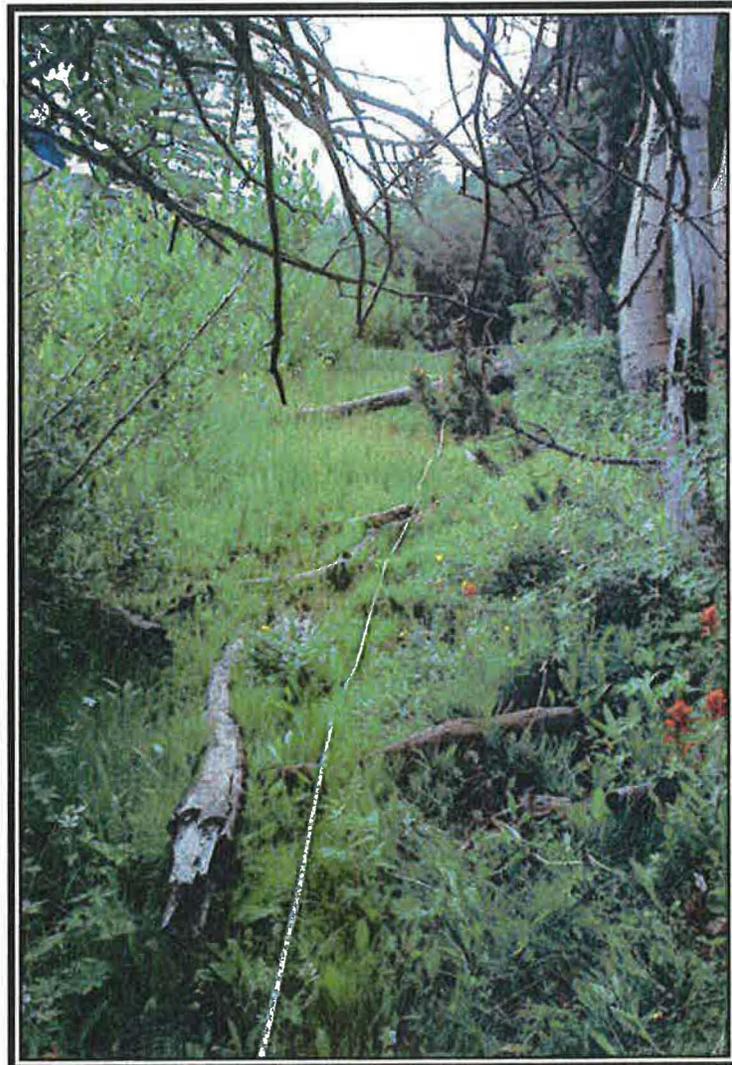
- 1) This is a well-defined spring area.*
- 2) A good control station; it is just outside current subsidence plans.*
- 3) When I placed the transect tape, it formed a "U" shape to measure. This tape was placed 4 ft from the upland bank for 82 ft of riparian/spring vegetation.*
- 4) For this sample period, the water area comprised about 15% coverage in the spring area and the vegetation about 85%.*
- 5) There was less impact from cattle trampling at the site this July (2015) compared to last July (2014).*
- 6) There was vegetation, water and mud present in the spring at the transect line.*
- 7) The site looked good this sample period.*

## DATA SUMMARY

### Q05S: Cover by plant community types in the South Fork Quitchupah Creek drainage (July 2015).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Salix boothii/Picea pungens</i>	2.00		
<i>Picea pungens/Populus tremuloides</i>		9.00	
			11.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Equisetum arvense</i>	10.00		
<i>Carex nebrascensis/Agrostis stolonifera/Ranunculus cymbalaria</i>	36.00	36.00	
			72.00
<b>TOTAL COVER (Upland Species)</b>			11.00
<b>TOTAL COVER (Riparian Species)</b>			82.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			0.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>93.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q05S

**RIPARIAN COMPLEX DATA SHEET**

**July 2015**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q065*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *July 7-9, 2015*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Late*

APPARENT FORAGE TREND: *Stable (adjacent spring); unstable (in spring)*

ESTIMATED FORAGE PRODUCTION: *100 lbs/acre in spring; 350 adjacent spring*

BEAVER ACTIVITY: *no*

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

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)
<i>Populus tremuloides</i>	<i>Ribes sp</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
	<i>Salix boothii</i>	<i>Taraxacum officinale</i>	<i>Poa pratensis</i>

POOL ATTRIBUTES

% area in pools: *100, 50% of the hoof-prints had water in them. It was dry last July (2014).*

% 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 (in spring depression)

% bank length vegetated, stable: *60*

% bank length unvegetated, stable: *0*

% bank length vegetated, unstable: *20*

% bank length unvegetated, unstable: *20*

NOTES:

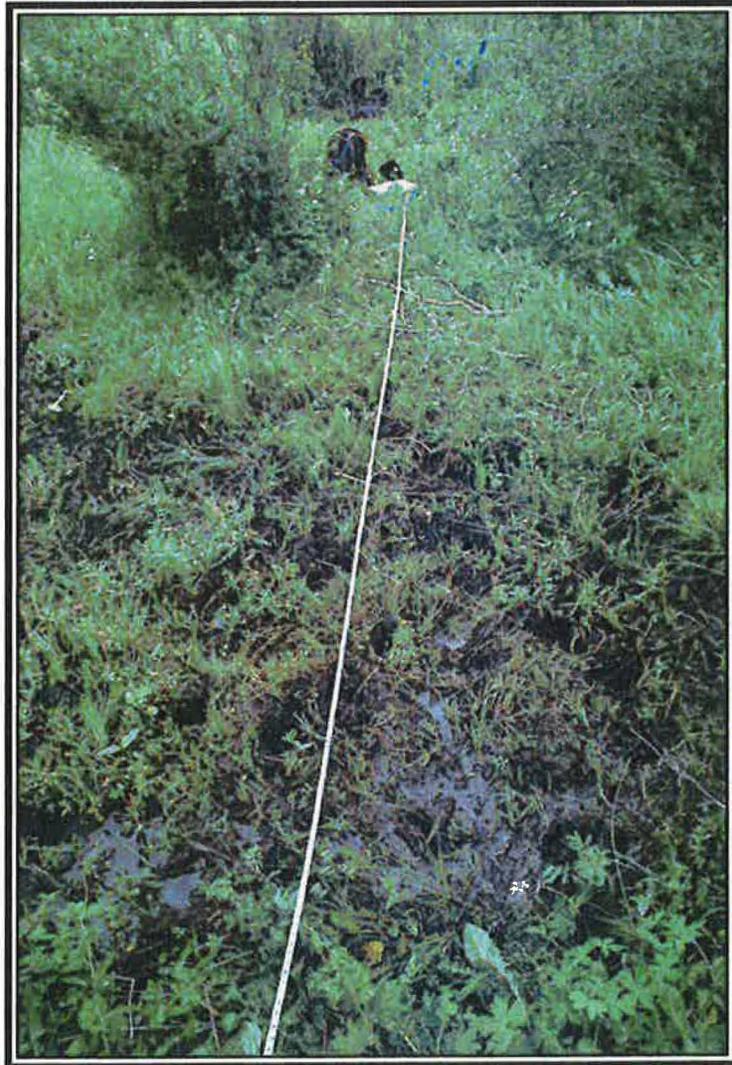
- 1) *Only measured obvious, well-defined spring area.*
- 2) *Left side measured to bank (3 ft).*
- 3) *Cattle had less impact for this sample period compared to last July (2014).*
- 4) *Riparian/wetland vegetation was measured in the spring channel and 1 ft up left bank.*
- 5) *Vegetation cover was 40% in the spring area and 90% in the adjacent uplands.*
- 6) *The sample station was located within current planned subsidence zone.*
- 7) *Judging from previous data it appears the composition has shifted from being dominated by wiregrass to red-top and buttercup.*
- 8) *There was less cattle impact probably resulting in more total living cover.*

## DATA SUMMARY

### Q06S: Cover by plant community types in the South Fork Quitchupah Creek drainage (July 2015).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Populus tremuloides/Salix boothii</i>	3.00		
<i>Symphoricarpos oreophilus/Grasses</i>		9.00	
			12.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Agrostis stolonifera/Ranunculus cymbalaria</i>	4.00	4.00	8.00
<b>TOTAL COVER (Upland Species)</b>			12.00
<b>TOTAL COVER (Riparian Species)</b>			8.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			0.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>20.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q06S

**RIPARIAN COMPLEX DATA SHEET**  
**July 2015**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q07C*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *July 7-9, 2015*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Mid-late*

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *1,300 lbs/acre*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *7*

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)
	<i>Rosa woodsii</i>	<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
	<i>Salix boothii</i>	<i>Trifolium sp.</i>	<i>Carex nebrascensis</i>
			<i>Hordeum jubatum</i>
			<i>Poa pratensis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *50 (all on right side)*  
 % bank length gently sloping (>135°): *100 incised (18") channel*  
 % bank length with overhanging vegetation: *100 on both sides; it was difficult to even see the stream water due to the vegetation.*

BANK CONDITION

% bank length vegetated, stable: *98*  
 % bank length unvegetated, stable: *1*  
 % bank length vegetated, unstable: *0*  
 % bank length unvegetated, unstable: *1*

NOTES:

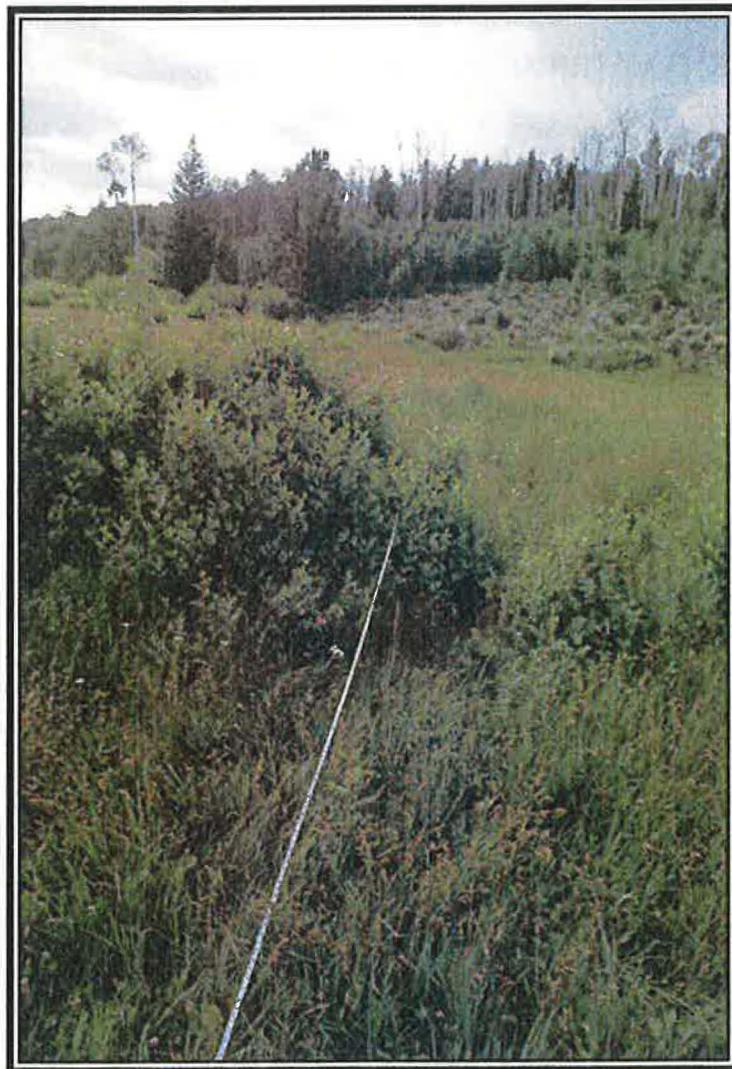
- 1) *This site is in the middle of a meadow.*
- 2) *Right side: This side had little upland vegetation (very little foxtail barley this sample period). It was mostly all riparian vegetation with more Nebraska sedge this period. I think these communities are dynamic and can show year-to-year differences 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.*
- 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. Vegetation in the meadow was tall and in good shape.*
- 4) *This site is within the current planned subsidence zone.*

## DATA SUMMARY

### **Q07C: Cover by plant community types in the South Fork Quitchupah Creek drainage (July 2015).**

<b>USDA Forest Service Protocol (1992)</b>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>	0.00		
<i>Poa pratensis/Achillea millefolium</i>		0.00	
<i>Poa pratensis/Achillea millefolium</i>			0.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Rosa woodsii</i>	7.00		
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis/Poa pratensis</i>	25.00	20.00	
<i>Juncus arcticus</i>	2.00		
			54.00
<b>TOTAL COVER (Upland Species)</b>			0.00
<b>TOTAL COVER (Riparian Species)</b>			54.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			1.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>55.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q07C

# RIPARIAN COMPLEX DATA SHEET

July 2015

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q08C*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *July 7-9, 2015*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Mid-late*

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)
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Trifolium sp.</i>	<i>Agrostis stolonifera</i>
	<i>Salix boothii</i>		<i>Carex nebrascensis</i>
			<i>Juncus arcticus</i>
			<i>Poa pratensis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

% streambed with filamentous algae: *0*  
 % stream margin with rooted aquatic: *rooted vegetation in the water*

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*  
 % bank length gently sloping (>135°): *100; the previous incised channel (18") had been filled in.*  
 % bank length with overhanging vegetation:

BANK CONDITION

% bank length vegetated, stable: *95*  
 % bank length unvegetated, stable: *3*  
 % bank length vegetated, unstable: *0*  
 % bank length unvegetated, unstable: *2*

NOTES:

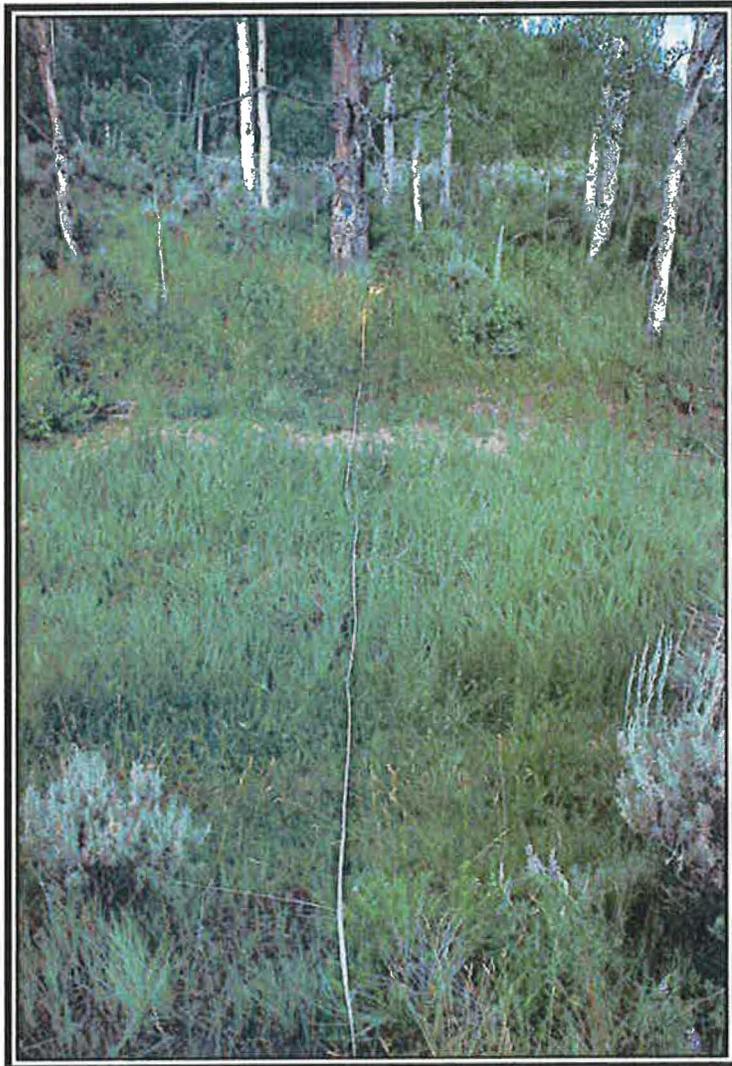
- 1) *This site had a straightforward area to monitor the riparian zone. The station went from low water to a low terrace, then a high terrace and finally to the aspen forest.*
- 2) *This site is within the current planned subsidence zone.*
- 3) *A 2013 precipitation event left a lot of sand outside the right side bank. This covered some of the riparian vegetation, so it reduced the riparian width (see Notes from July 2013).*
- 4) *Also, the water width was greater also decreasing riparian width by about 1 ft.*
- 5) *In 2015, the site looked more stable with more living cover than previous sample year.*

## DATA SUMMARY

### Q08C: Cover by plant community types in the South Fork Quitchupah Creek drainage (July 2015).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Artemisia tridentata/Grasses</i>	10.00		
<i>Populus tremuloides/Symphoricarpos oreophilus</i>		15.00	
			25.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis</i>	1.50	4.00	
<i>Agrostis stolonifera/Carex nebrascensis</i>		5.00	
<i>Agrostis stolonifera</i>	6.00		16.50
<b>TOTAL COVER (Upland Species)</b>			25.00
<b>TOTAL COVER (Riparian Species)</b>			16.50
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			2.50
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			44.00

## PHOTOGRAPHIC DOCUMENTATION



Q08C

**RIPARIAN COMPLEX DATA SHEET**

**July 2015**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q09C*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *July 7-9, 2015*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Changed to "early" due to flooding.*

APPARENT FORAGE TREND: *Now unstable*

ESTIMATED FORAGE PRODUCTION: *300 lbs/acre*

BEAVER ACTIVITY: *no*

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

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)
	<i>Artemisia tridentata</i>	<i>Trifolium sp.</i>	<i>Agrostis stolonifera</i>
	<i>Rosa woodsii</i>		<i>Juncus arcticus</i>
	<i>Salix boothii</i>		<i>Poa pratensis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *changed to 0*  
 % bank length gently sloping (>135°): *100*  
 % bank length with overhanging vegetation: *(herbaceous only)*

BANK CONDITION

% bank length vegetated, stable: *50*  
 % bank length unvegetated, stable: *30*  
 % bank length vegetated, unstable: *10*  
 % bank length unvegetated, unstable: *10*

NOTES:

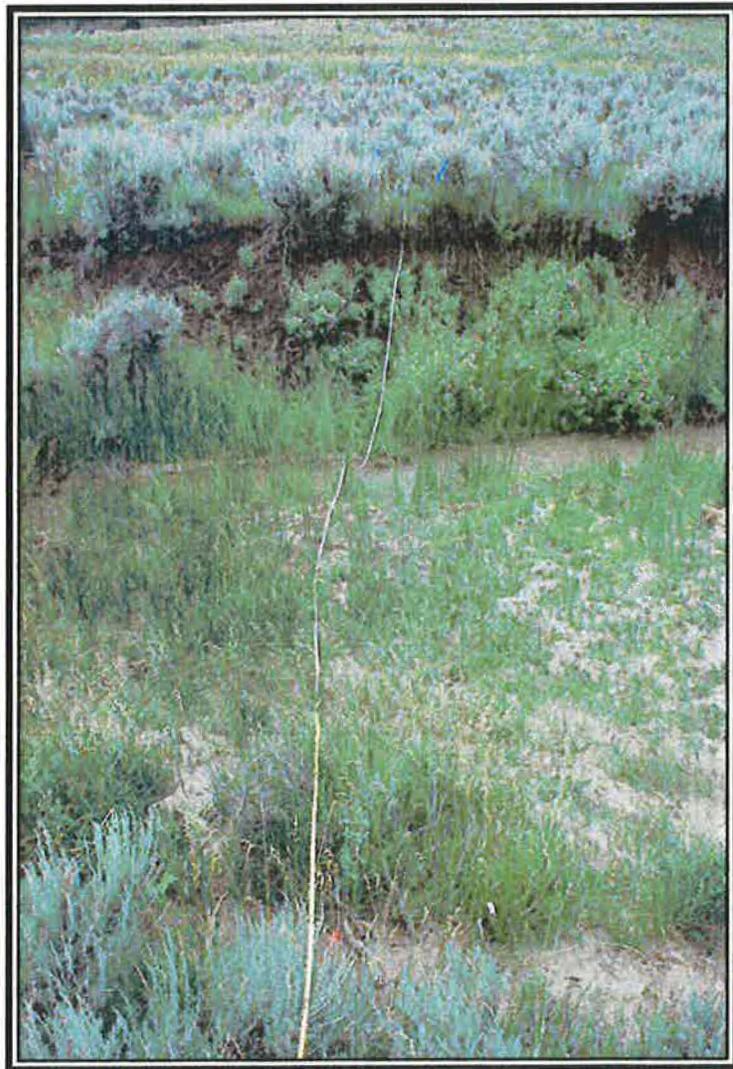
- 1) *This site was once more of a straightforward area to monitor the riparian zone.*
- 2) *This site is within the current planned subsidence zone.*
- 3) *In 2014 & 2015, the length of the transect line decreased by 2 ft, probably due to flooding mentioned in the 2013 notes. The channel was covered by a lot of sand, so it became less incised. This may have resulted in a decrease in the transect length. Also the right bank sloughed off possibly causing some decreased length too.*

## DATA SUMMARY

### Q09C: Cover by plant community types in the South Fork Quitchupah Creek drainage (July 2015).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>	8.00		
<i>Artemisia tridentata/Grasses</i>		7.00	
<i>Artemisia tridentata/Grasses</i>			15.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Agrostis stolonifera/Carex nebrascensis</i>		5.50	
<i>Juncus arcticus</i>	11.00		16.50
<b>TOTAL COVER (Upland Species)</b>			15.00
<b>TOTAL COVER (Riparian Species)</b>			16.50
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			2.50
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>34.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q09C

**RIPARIAN COMPLEX DATA SHEET**

**July 2015**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q105*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *July 7-9, 2015*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

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)
<i>Cornus sericea</i>		<i>Equisetum arvense</i>	
<i>Populus tremuloides</i>		<i>Viola adunca</i>	
<i>Pseudotsuga menziesii</i>			
<i>Rosa woodsii</i>			

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*  
 % bank length gently sloping (>135°): *75 (average)*  
 % bank length with overhanging vegetation: *50 (conifers)*

BANK CONDITION

	<u>Spring channel</u>	<u>Outside channel</u>
% bank length vegetated, stable:	<i>5</i>	<i>50</i>
% bank length unvegetated, stable:	<i>75</i>	<i>50</i>
% bank length vegetated, unstable:	<i>0</i>	<i>0</i>
% bank length unvegetated, unstable:	<i>20</i>	<i>0</i>

NOTES:

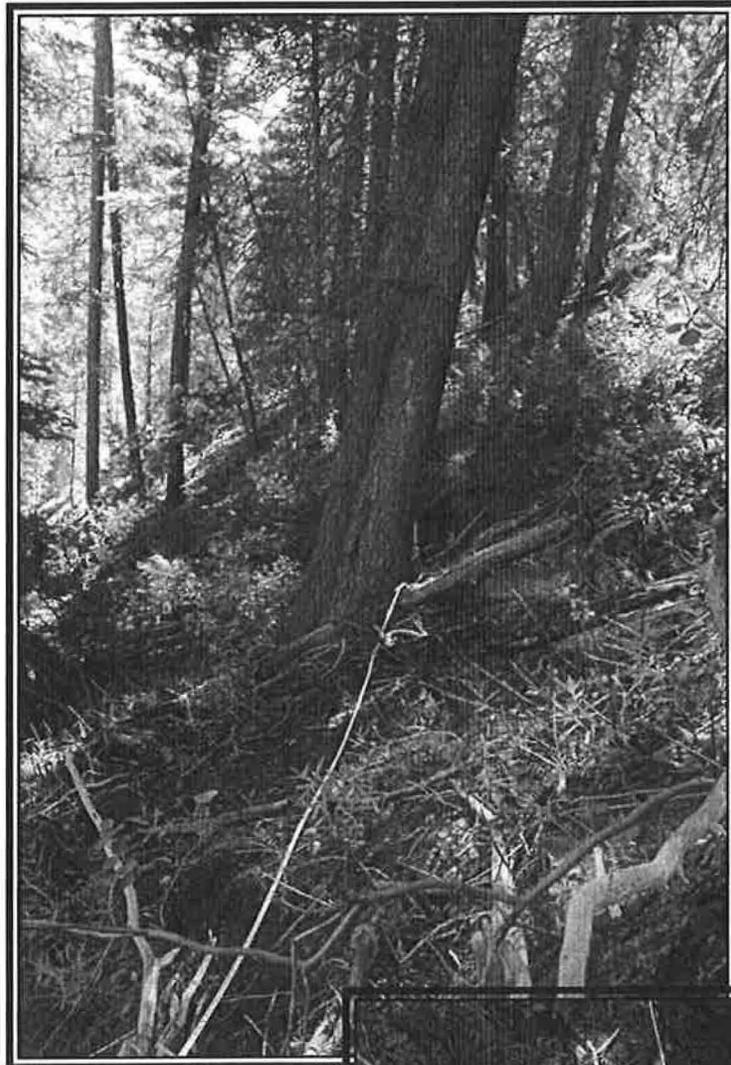
- 1) *This site, also called Wedge Spring, is often measured for flow by a hydrologist.*
- 2) *It had rather low vegetative cover (see closeup photograph).*
- 3) *No water surfaced here this sample period.*
- 4) *There was less horsetail on the left side with from the previously describe hillside moisture - enough less it may now be considered upland? The right side had more dogwood.*
- 5) *The spring was dry. Area was moist, but I think it was from the previous rainstorm.*

## DATA SUMMARY

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

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>	0.00		
<i>Conifer</i>		15.00	
<i>Conifer</i>			15.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Cornus sericea/Equisetum arvense</i>		25.00	
<u>Dominant Herbaceous Species</u>			
<i>Equisetum arvense</i>	7.00	20.00	
			52.00
<b>TOTAL COVER (Upland Species)</b>			15.00
<b>TOTAL COVER (Riparian Species)</b>			52.00
<b>ROCK (channel)</b>			1.00
<b>WATER (channel)</b>			0.00
<b>BAREGROUND/MUD (channel)</b>			1.00
<b>LITTER (channel)</b>			8.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>77.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q10S



Q10S (close-up)

**RIPARIAN COMPLEX DATA SHEET**  
**July 2015**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q11C*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *July 7-9, 2015*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Early due to floods and maybe other disturbance.*

APPARENT FORAGE TREND: *Decreasing but seemed more stable than last sample period.*

ESTIMATED FORAGE PRODUCTION: *400 lbs/acre*

BEAVER ACTIVITY: *Yes (upstream)*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *3 (more stable due to 2013 flood deposits)*

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)
<i>Abies concolor</i>	<i>Chrysothamnus nauseosus</i>	<i>Trifolium sp.</i>	<i>Agrostis stolonifera</i>
<i>Cornus sericea</i>			<i>Juncus arcticus</i>
<i>Populus tremuloides</i>			<i>Poa pratensis</i>
<i>Pseudotsuga menziesii</i>			
<i>Salix lutea?</i>			

POOL ATTRIBUTES

% area in pools: *70*

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

AQUATIC VEGETATION

% streambed with filamentous algae: *0*

% stream margin with rooted aquatic: *0*

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*

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

% bank length with overhanging vegetation: *50*

BANK CONDITION

% bank length vegetated, stable: *80*

% bank length unvegetated, stable: *5*

% bank length vegetated, unstable: *5*

% bank length unvegetated, unstable: *10*

NOTES:

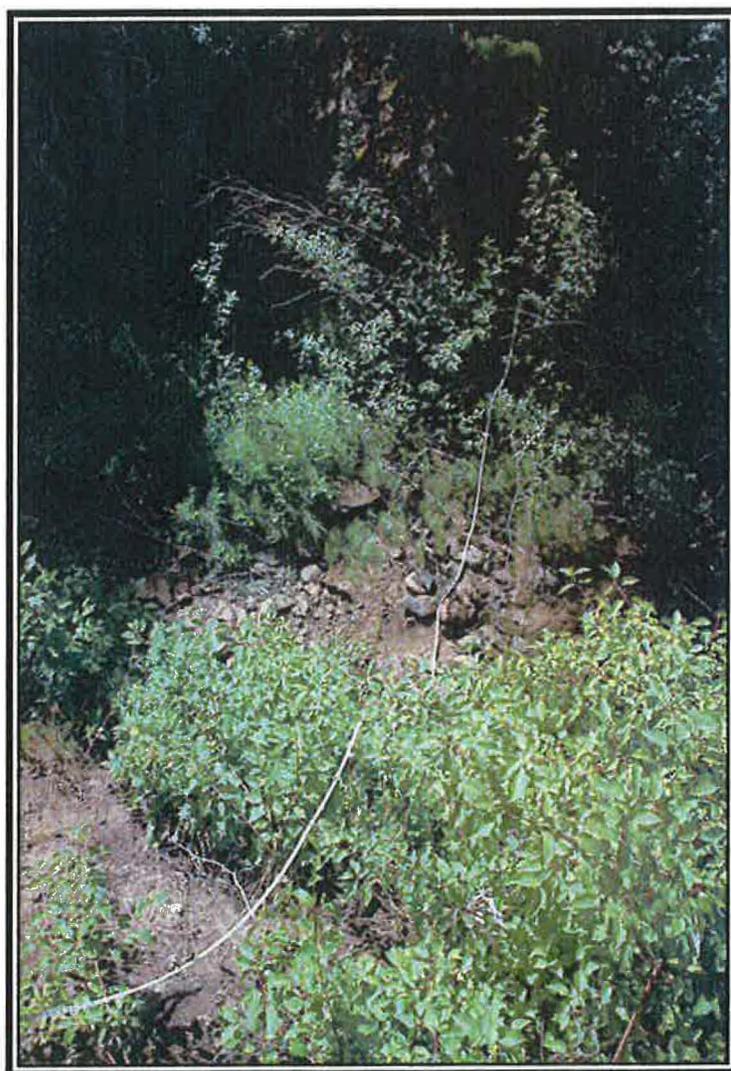
- 1) 2013 flooding seemed to have greatly impacted the riparian community here, but the dogwood recovered, is growing and regaining vigor.
- 2) This site was placed at water sampling station (called 006D).
- 3) There was a rockslide upstream about 0.4 miles (below site 105).
- 4) The beaver dam upstream had less water in it.
- 5) The vegetation here looked good.

## DATA SUMMARY

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

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Populus tremuloides/Abies concolor</i>	3.00		
<i>Pseudotsuga menziesii</i>		0.00	
			3.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Cornus sericea</i>	13.00	3.00	
<u>Dominant Herbaceous Species</u>			
<i>Equisetum arvense</i>		4.00	20.00
<b>TOTAL COVER (Upland Species)</b>			3.00
<b>TOTAL COVER (Riparian Species)</b>			20.00
<b>ROCK (channel)</b>			4.00
<b>WATER (channel)</b>			3.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>30.00</b>

## PHOTOGRAPHIC DOCUMENTATION



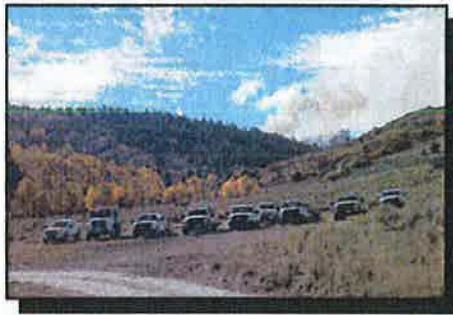
Q11C

# SECTION B

## RIPARIAN COMPLEX DATA SHEETS

for the

OCTOBER 2015  
SAMPLE PERIOD



USFS Vehicles



Prescribed Burn Near Sample Areas in October 2015

**RIPARIAN COMPLEX DATA SHEET**  
**October 2015**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q01C*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 1-2, 2015*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

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

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

ESTIMATED FORAGE PRODUCTION: *700 lbs/acre*

BEAVER ACTIVITY: *no*

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

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)
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Achillea millefolium</i>	<i>Carex nebrascensis</i>
<i>Salix boothii</i>	<i>Rosa woodsii</i>	<i>Taraxacum officinale</i>	<i>Juncus arcticus</i>
	<i>Symphoricarpos oreophilus</i>		<i>Poa pratensis</i>

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 (<90°): *0*

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

% bank length with overhanging vegetation: *10 (short Booth's willows)*

BANK CONDITION

% bank length vegetated, stable: *80*

% bank length unvegetated, stable: *15*

% bank length vegetated, unstable: *0*

% bank length unvegetated, unstable: *5*

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) *All stakes were found.*

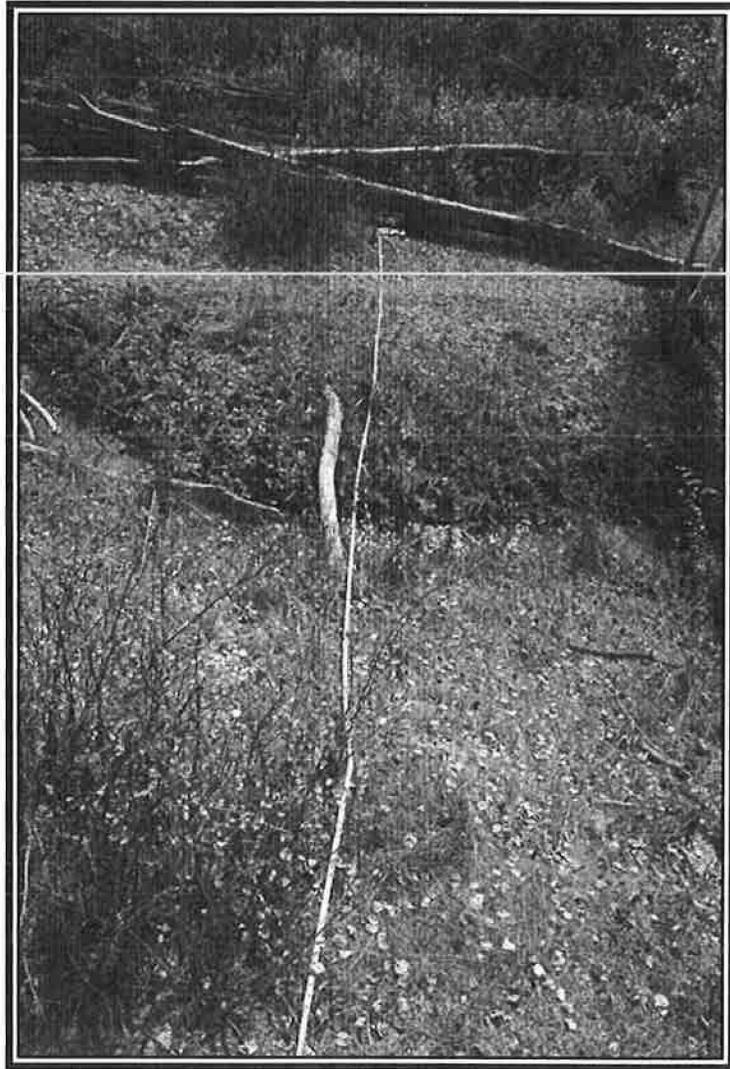
5) *A prescribed burn was planned by the USFS on our sample day. We spoke with the fire experts onsite describing our sample plans. Consequently, to save time, they graciously gave us permission to take our UTV and escorted us to our sample sites. One FS field worker remained with us while we sampled for safety purposes. This was much appreciated!*

## DATA SUMMARY

### Q01C: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2015).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Symphoricarpos oreophilus/Artemisia tridentata/Poa pratensis</i>	10.00		
<i>Poa pratensis/Taraxacum officinale</i>		8.00	18.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Rosa woodsii</i>			
<u>Dominant Herbaceous Species</u>			
<i>Equisetum arvense</i>			
<i>Carex nebrascensis</i>		4.00	
<i>Juncus arcticus</i>	3.00	2.00	9.00
<b>TOTAL COVER (Upland Species)</b>			18.00
<b>TOTAL COVER (Riparian Species)</b>			9.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			2.00
<b>BAREGROUND (channel)</b>			1.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>30.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q01C

**RIPARIAN COMPLEX DATA SHEET**  
**October 2015**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q025*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 1-2, 2015*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Early*

APPARENT FORAGE TREND: *Decreasing (ground cover was mud and vegetation in the riparian area)*

ESTIMATED FORAGE PRODUCTION: *Spring 40 lbs/acre; adjacent uplands 700*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *Inside of spring =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)
<i>Picea pungens</i>	<i>Ribes sp.</i>	<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Symphoricarpos oreophilus</i>	<i>Equisetum arvense</i>	<i>Carex nebrascensis</i>
		<i>Ranunculus cymbalaria</i>	<i>Poa pratensis</i>
		<i>Taraxacum officinale</i>	

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

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

BANK CONDITION

	<u>Center</u>	<u>Side</u>
% bank length vegetated, stable:	<i>0</i>	<i>55</i>
% bank length unvegetated, stable:	<i>0</i>	<i>0</i>
% bank length vegetated, unstable:	<i>0</i>	<i>20</i>
% bank length unvegetated, unstable:	<i>100</i>	<i>25</i>

NOTES:

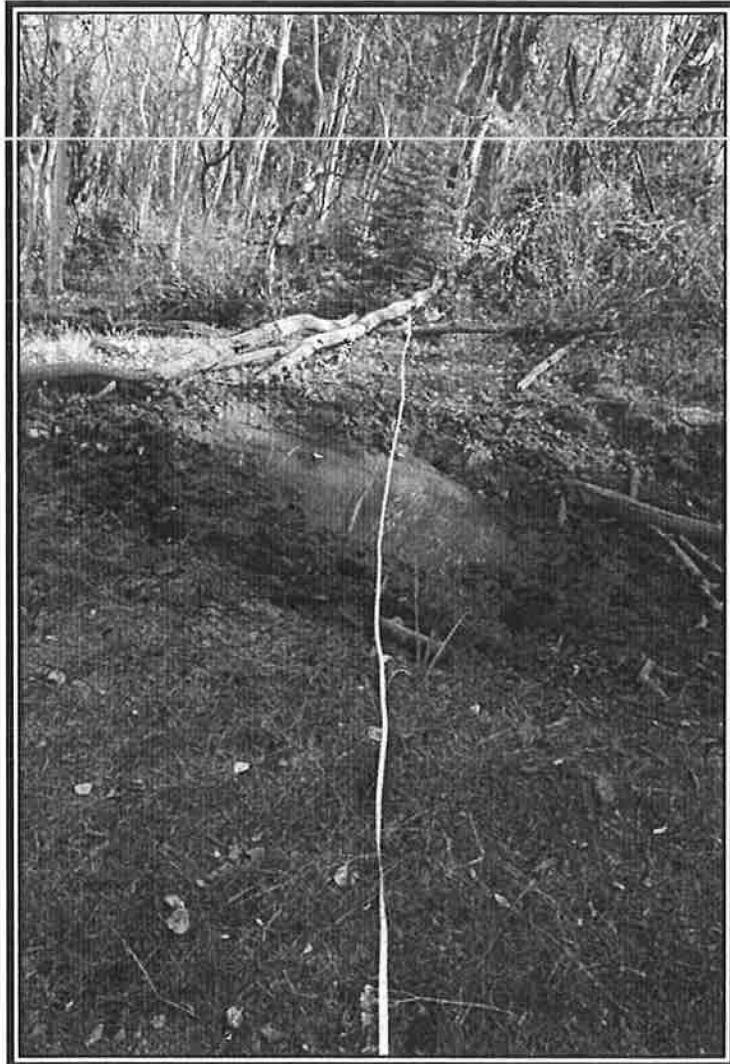
- 1) *This is a spring area.*
- 2) *Probably a good "control" site (outside the subsidence zone).*
- 3) *There were lots of cattle hoof-prints (disturbance). Most all vegetation had been remove by animals.*
- 4) *All stakes were located.*
- 5) *It appeared the spring had been dug out (see photo) to create water for cattle?*
- 6) *Consequently, the spring consisted of a 6 ft diameter pool with almost no riparian vegetation and muddy banks.*

## DATA SUMMARY

### Q02S: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2015).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Poa pratensis</i> / <i>Achillea millefolium</i>	10.00		
<i>Geranium richardsonii</i> / <i>Poa pratensis</i>		9.00	19.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Agrostis stolonifera</i>		1.00	1.00
<b>TOTAL COVER (Upland Species)</b>			19.00
<b>TOTAL COVER (Riparian Species)</b>			1.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			6.00
<b>BAREGROUND (channel)</b>			7.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>33.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q02S

**RIPARIAN COMPLEX DATA SHEET**  
**October 2015**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q03C*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 1-2, 2015*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

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

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

ESTIMATED FORAGE PRODUCTION: *700 lbs/acre (lots of cattle use since July)*

BEAVER ACTIVITY: *no*

EROSION RATING (1=negligible; 2=slight; 3=moderate; 4=severe; 5=extreme): *2 (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)
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Aster sp.</i>	<i>Agrostis stolonifera</i>
	<i>Rosa woodsii</i>	<i>Equisetum arvense</i>	<i>Juncus arcticus</i>
	<i>Salix spp.</i>	<i>Taraxacum officinale</i>	

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0 on both sides due to flooding.*  
 % bank length gently sloping (>135°): *0*  
 % bank length with overhanging vegetation: *0*

BANK CONDITION

% bank length vegetated, stable: *85*  
 % bank length unvegetated, stable: *15*  
 % bank length vegetated, unstable: *0*  
 % bank length unvegetated, unstable: *0*

NOTES:

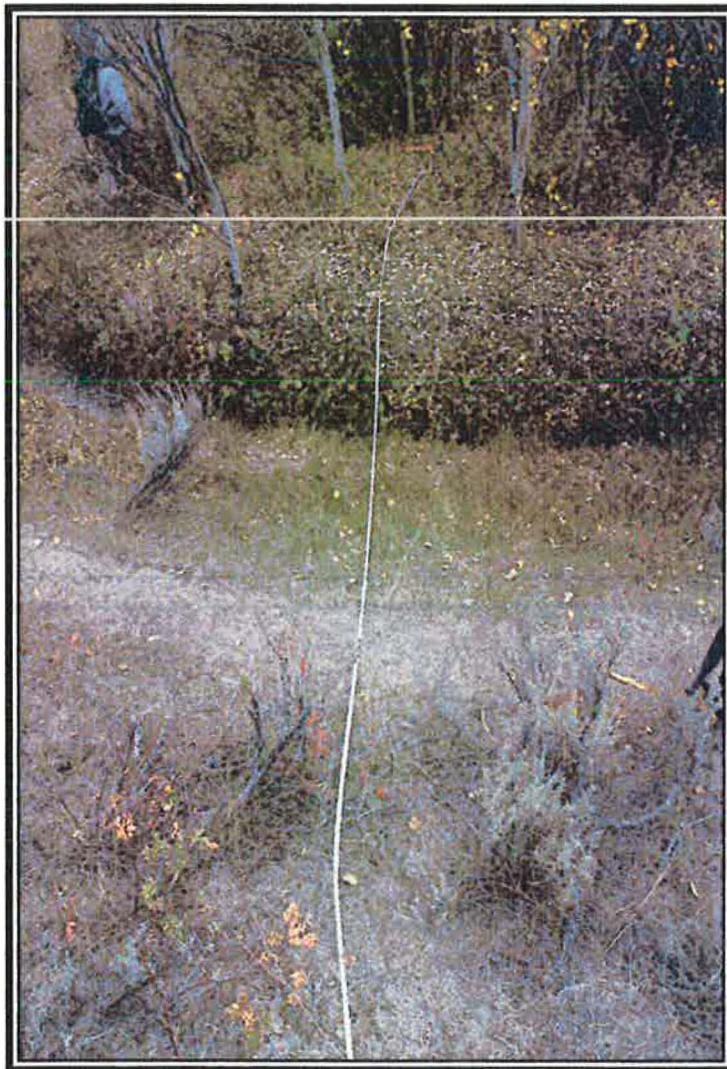
- 1) *This is a channel site.*
- 2) *A good control station; outside current subsidence plans.*
- 3) *It seems like we needed a sample here, but this may be more difficult to monitor as accurately due to the topography. The narrow channel sites are more straight-forward to monitor than this type.*
- 4) *Interestingly, the adjacent aspen understory (that I considered upland) continues to have 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.*

## DATA SUMMARY

### Q03C: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2015).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Artemisia tridentata/Elymus salinus</i>	10.00		
<i>Populus tremuloides/Juncus arcticus</i>		14.00	
			24.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Agrostis stolonifera</i>	3.00	2.00	
<i>Juncus arcticus</i>	4.00		9.00
<b>TOTAL COVER (Upland Species)</b>			24.00
<b>TOTAL COVER (Riparian Species)</b>			9.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			2.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>35.00</b>

PHOTOGRAPHIC DOCUMENTATION



Q03C

**RIPARIAN COMPLEX DATA SHEET**  
**October 2015**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q045*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 1-2, 2015*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Late*

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): *2 (lots of 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)
<i>Picea pungens</i>	<i>Rosa woodsii</i>	<i>Achillea millefolium</i>	<i>Eleocharis palustris</i>
<i>Populus tremuloides</i>	<i>Salix boothii</i>	<i>Equisetum arvense</i>	<i>Hordeum jubatum</i>
		<i>Geranium richardsonii</i>	<i>Juncus arcticus</i>
			<i>Juncus longistylis</i>
			<i>Poa pratensis</i>

POOL ATTRIBUTES

% area in pools: *100*

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

AQUATIC VEGETATION

% streambed with filamentous algae: *0*

% stream margin with rooted aquatic: *0*

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*

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

% bank length with overhanging vegetation: *50*

BANK CONDITION

% bank length vegetated, stable: *75*

% bank length unvegetated, stable: *10*

% bank length vegetated, unstable: *0*

% bank length unvegetated, unstable: *15*

NOTES:

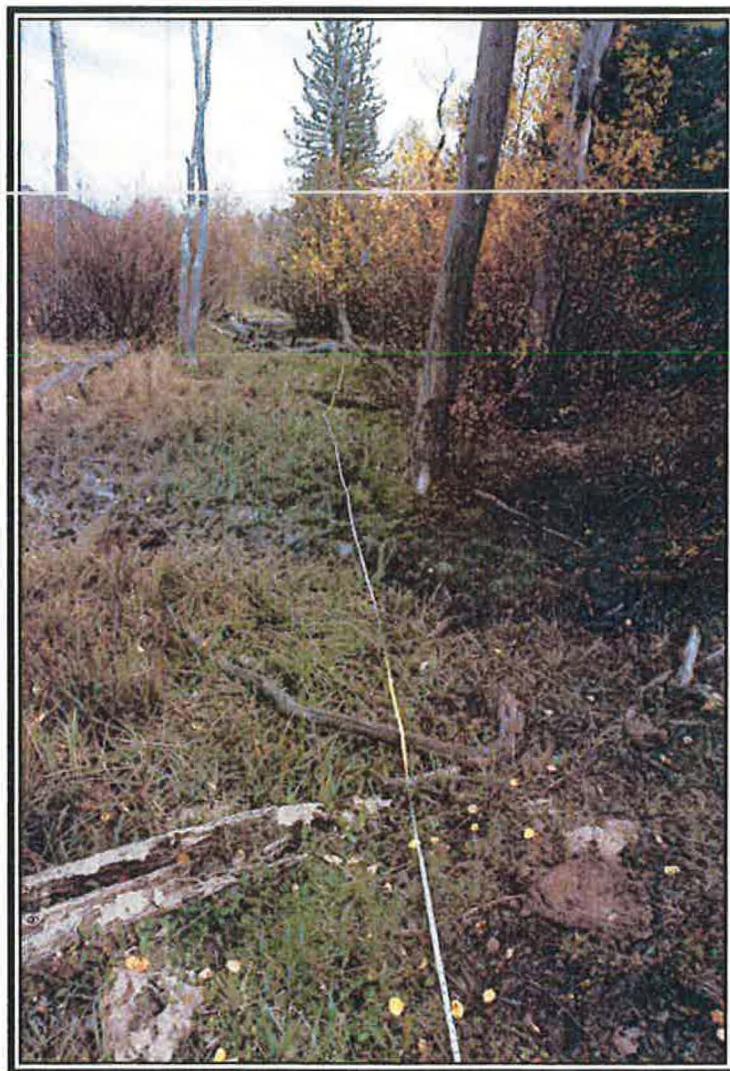
- 1) *This is a spring area.*
- 2) *It is a good control station; outside current subsidence plans.*
- 3) *There was not a lot of water here except that in the hoof-prints.*
- 4) *Nebraska sedge dominated the wettest areas. Left side riparian vegetation changed to more upland species.*

## DATA SUMMARY

### Q04S: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2015).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Symphoricarpos oreophilus/Populus tremuloides</i>	9.00	10.00	19.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Ranunculus cymbalaria/Carex nebrascensis</i>			
<i>Carex nebrascensis</i>	7.00		
<i>Carex nebrascensis/Agrostis stolonifera</i>		32.00	39.00
<b>TOTAL COVER (Upland Species)</b>			19.00
<b>TOTAL COVER (Riparian Species)</b>			39.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			2.00
<b>BAREGROUND/MUD (channel)</b>			6.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>56.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q04S

**RIPARIAN COMPLEX DATA SHEET**  
**October 2015**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q055*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 1-2, 2015*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Late*

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

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

BEAVER ACTIVITY: *Yes, just upstream*

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

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)
<i>Abies concolor</i>	<i>Salix boothii</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
<i>Picea pungens</i>	<i>Symphoricarpos oreophilus</i>	<i>Geranium richardsonii</i>	<i>Carex nebrascensis</i>
<i>Pinus flexilis</i>		<i>Ranunculus cymbalaria</i>	
<i>Populus tremuloides</i>			

POOL ATTRIBUTES

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

AQUATIC VEGETATION

% streambed with filamentous algae: *0*  
 % stream margin with rooted aquatic: *100 in spring*

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: *70*  
 % bank length unvegetated, stable: *10*  
 % bank length vegetated, unstable: *15*  
 % bank length unvegetated, unstable: *5*

NOTES:

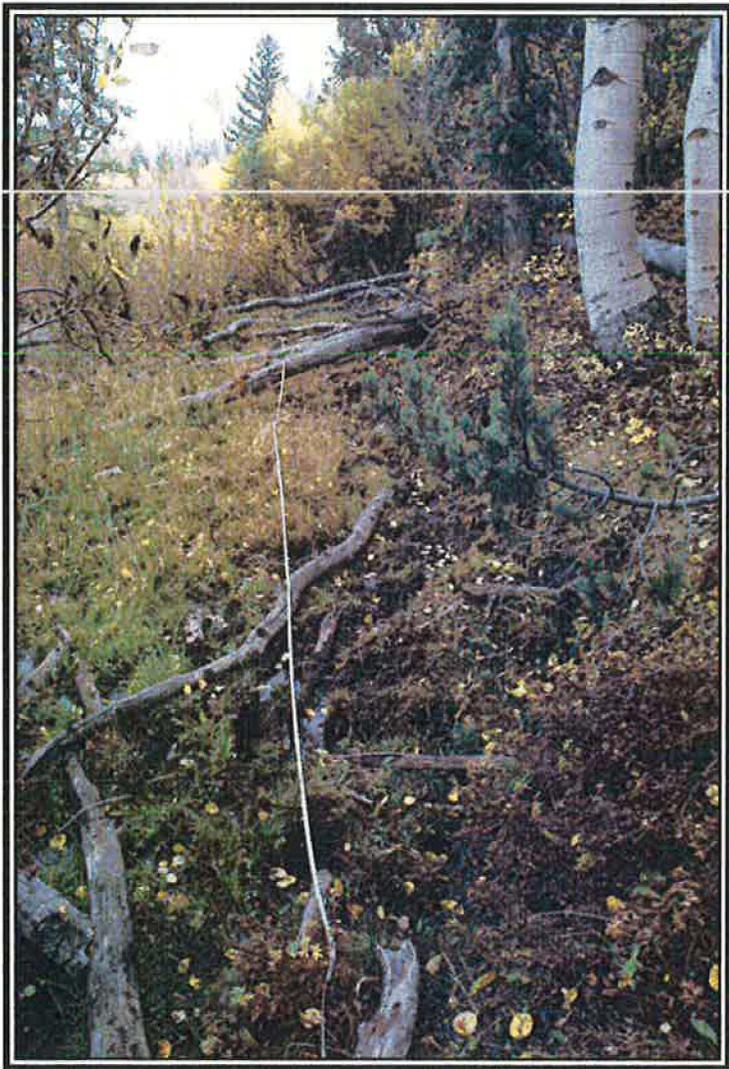
- 1) *This is a well-defined spring area.*
- 2) *A good control station; it is just outside current subsidence plans.*
- 3) *When I placed the transect tape, it formed a "U" shape to measure. This tape was placed 4 ft from the upland bank for 82 ft of riparian/spring vegetation.*
- 4) *For this sample period, there was not a lot of water other than that in all the hoof-prints.*
- 5) *Nebraska sedge dominated the wettest areas.*
- 6) *In October 2015, there was about 20% water cover and 80% vegetation. It looked better this year.*

## DATA SUMMARY

**Q05S: Cover by plant community types in the South Fork  
 Quitchupah Creek drainage (October 2015).**

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Salix boothii/Picea pungens</i>	10.00		
<i>Picea pungens/Populus tremuloides</i>		8.00	
			18.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis/Agrostis stolonifera/Ranunculus cymbalaria</i>	37.50	37.50	
			75.00
<b>TOTAL COVER (Upland Species)</b>			18.00
<b>TOTAL COVER (Riparian Species)</b>			75.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			0.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>93.00</b>

PHOTOGRAPHIC DOCUMENTATION



Q05S

**RIPARIAN COMPLEX DATA SHEET**  
**October 2015**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q065*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 1-2, 2015*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Late*

APPARENT FORAGE TREND: *Only semi-stable due to cattle impacts*

ESTIMATED FORAGE PRODUCTION: *50 lbs/acre in the spring; 400 in the adjacent to it.*

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)
<i>Populus tremuloides</i>	<i>Ribes sp</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
	<i>Salix boothii</i>	<i>Taraxacum officinale</i>	<i>Poa pratensis</i>

POOL ATTRIBUTES

% area in pools: *100 (There was water in all hoof-prints).*  
 % 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: *25*  
 % bank length unvegetated, stable: *0*  
 % bank length vegetated, unstable: *40*  
 % bank length unvegetated, unstable: *35 (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.*
- 4) *Riparian/wetland vegetation was measured in the spring channel only.*
- 5) *Vegetation cover was 25% in the spring area and 75% in the adjacent uplands.*
- 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 2015).**

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Populus tremuloides/Salix boothii</i>	3.00		
<i>Symphoricarpos oreophilus/Grasses</i>		9.00	12.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis/Agrostis stolonifera</i>	4.00	4.00	7.00
<b>TOTAL COVER (Upland Species)</b>			12.00
<b>TOTAL COVER (Riparian Species)</b>			8.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			0.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			20.00

## PHOTOGRAPHIC DOCUMENTATION



Q06S

**RIPARIAN COMPLEX DATA SHEET**  
**October 2015**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q07C*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 1-2, 2015*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Late*

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *1,200 lbs/acre (cattle grazed during the summer)*

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)
	<i>Rosa woodsii</i>	<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
	<i>Salix boothii</i>	<i>Trifolium sp.</i>	<i>Carex nebrascensis</i>
			<i>Hordeum jubatum</i>
			<i>Poa pratensis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *50 on right side*  
 % bank length gently sloping (>135°): *100 incised (18") channel*  
 % bank length with overhanging vegetation: *100 on both sides; it was difficult to even see the stream water due to the vegetation*

BANK CONDITION

% bank length vegetated, stable: *98*  
 % bank length unvegetated, stable: *7*  
 % bank length vegetated, unstable: *0*  
 % bank length unvegetated, unstable: *7*

NOTES:

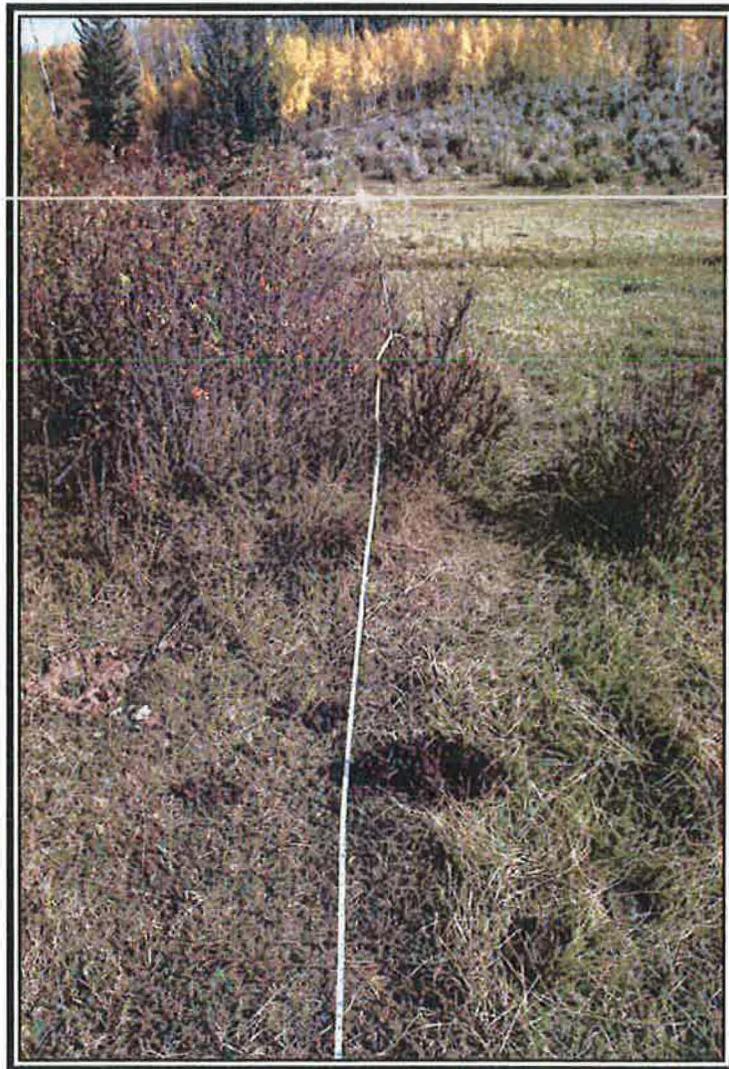
- 1) *This site is in the middle of a meadow.*
- 2) *Right side: This area looked different than earliest sample periods. Now the transect line was mostly all riparian vegetation with a lot Nebraska sedge. I think these communities are dynamic and can show year-to-year differences based on water regimes. 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.*
- 4) *There was evidence of a major flood here in 2013. The flood impacts were more depositional than erosional.*
- 5) *This site is within the current planned subsidence zone.*

## DATA SUMMARY

**Q07C: Cover by plant community types in the South Fork  
 Quitchupah Creek drainage (October 2015).**

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>	0.00		
<i>Poa pratensis/Achillea millefolium</i>		0.00	
<i>Poa pratensis/Achillea millefolium</i>			0.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Rosa woodsii</i>	7.00		
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis</i>	16.50		
<i>Carex nebrascensis/Poa pratensis</i>	11.00	20.50	
			54.00
<b>TOTAL COVER (Upland Species)</b>			0.00
<b>TOTAL COVER (Riparian Species)</b>			55.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			1.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>56.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q07C

**RIPARIAN COMPLEX DATA SHEET**  
**October 2015**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q08C*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 1-2, 2015*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Early due to flooding.*

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 (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)
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Trifolium sp.</i>	<i>Agrostis stolonifera</i>
	<i>Salix boothii</i>		<i>Carex nebrascensis</i>
			<i>Juncus arcticus</i>

POOL ATTRIBUTES

% area in pools: *0*

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

AQUATIC VEGETATION

% streambed with filamentous algae: *0*

% stream margin with rooted aquatic: *100 (in water area)*

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*

% bank length gently sloping (>135°): *100. The incised channel was filled in with past flooding.*

% bank length with overhanging vegetation:

BANK CONDITION

% bank length vegetated, stable: *90*

% bank length unvegetated, stable: *5*

% bank length vegetated, unstable: *0*

% bank length unvegetated, unstable: *5*

NOTES:

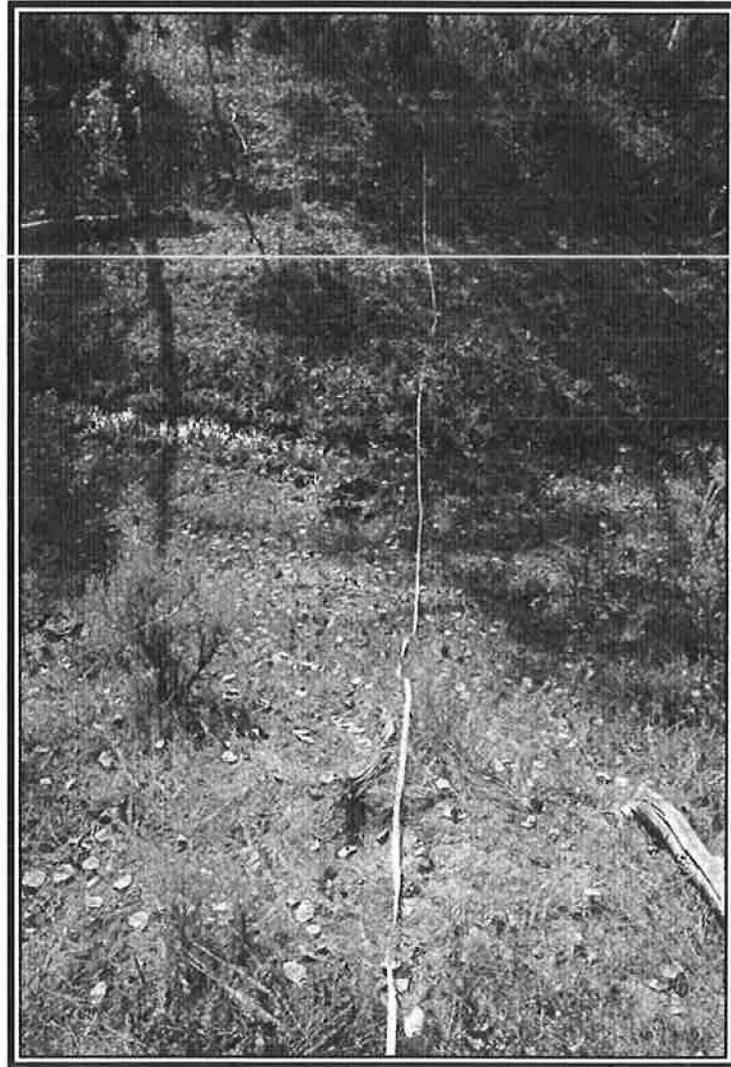
- 1) *This site had a straightforward area to monitor the riparian zone. The station went from low water to a low terrace, then a high terrace and finally to the aspen forest.*
- 2) *This site is within the current planned subsidence zone.*
- 3) *There was evidence of a major flood here (see 2013 data). 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.*
- 4) *Site appears to have stabilized.*
- 5) *Lots of cattle use.*

## DATA SUMMARY

### Q08C: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2015).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Artemisia tridentata/Grasses</i>	10.00		
<i>Populus tremuloides/Symphoricarpos oreophilus</i>		15.00	
			25.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Rosa woodsii</i>			
<u>Dominant Herbaceous Species</u>			
<i>Carex nebrascensis</i>	2.00	10.00	
<i>Carex nebrascensis/Agrostis stolonifera</i>	6.00		
			18.00
<b>TOTAL COVER (Upland Species)</b>			25.00
<b>TOTAL COVER (Riparian Species)</b>			18.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			1.00
<b>BAREGROUND (channel)</b>			0.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>44.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q08C

**RIPARIAN COMPLEX DATA SHEET**  
**October 2015**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q09C*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 1-2, 2015*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Early due to floods*

APPARENT FORAGE TREND: *Unstable*

ESTIMATED FORAGE PRODUCTION: *300 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)
	<i>Artemisia tridentata</i>	<i>Trifolium sp.</i>	<i>Agrostis stolonifera</i>
	<i>Rosa woodsii</i>		<i>Juncus arcticus</i>
	<i>Salix boothii</i>		<i>Poa pratensis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

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

BANK CONDITION

% bank length vegetated, stable: *45*  
 % bank length unvegetated, stable: *25*  
 % bank length vegetated, unstable: *10*  
 % bank length unvegetated, unstable: *20*

NOTES:

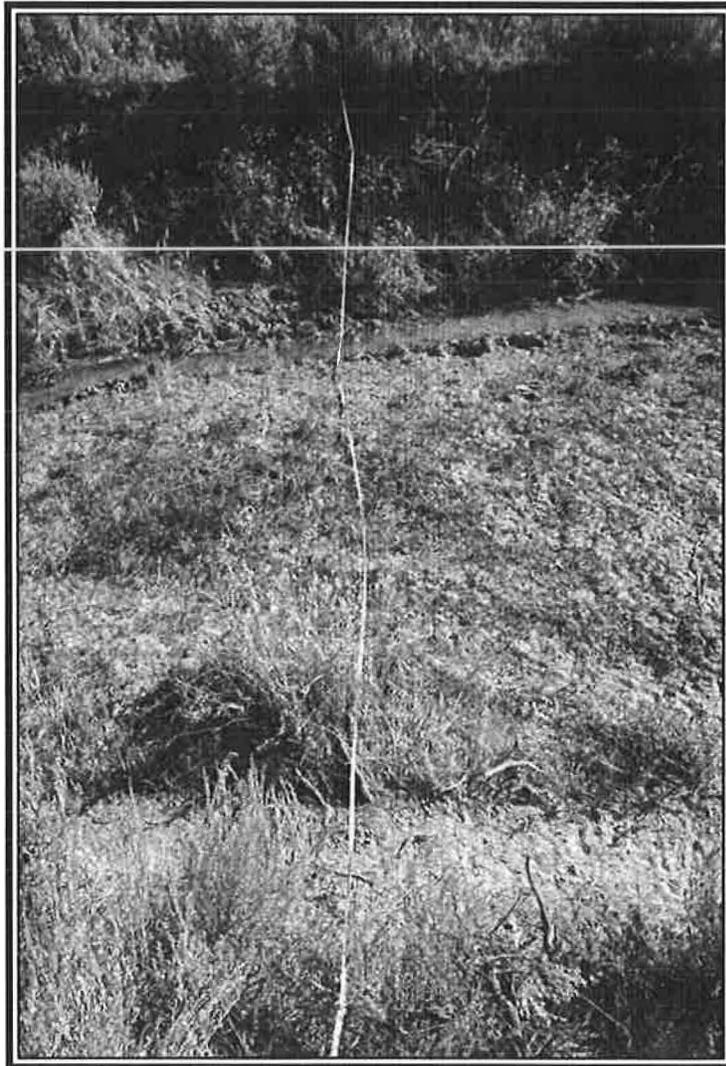
- 1) *This site is a straightforward area to monitor the riparian zone.*
- 2) *This site is within the current planned subsidence zone.*
- 3) *In 2014 & 2015, the length of the transect line decreased by 2 ft, probably due to flooding mentioned in the 2013 notes. The channel was covered by a lot of sand, so it became less incised. This may have resulted in a decrease in the transect length. Also the right bank sloughed off possibly causing some decreased length too.*
- 4) *The right side had sloughed off so much it was about 1 ft from the wooden stake.*

## DATA SUMMARY

### Q09C: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2015).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>	8.00		
<i>Artemisia tridentata/Grasses</i>		9.00	
<i>Artemisia tridentata/Grasses</i>			17.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Rosa woodsii</i>		2.00	
<u>Dominant Herbaceous Species</u>			
<i>Juncus arcticus</i>	12.00		
			14.00
<b>TOTAL COVER (Upland Species)</b>			17.00
<b>TOTAL COVER (Riparian Species)</b>			14.00
<b>ROCK (channel)</b>			0.00
<b>WATER (channel)</b>			2.00
<b>BAREGROUND/MUD (channel)</b>			1.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>34.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q09C

**RIPARIAN COMPLEX DATA SHEET**  
**October 2015**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q705*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 1-2, 2015*

OBSERVER(S): *P. Collins, G. McMillan*

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
<i>(refer to quantitative data results for this information)</i>	

COMMUNITY SUCCESSIONAL STAGE: *Unstable*

APPARENT FORAGE TREND: *Unstable*

ESTIMATED FORAGE PRODUCTION: *75 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)
<i>Cornus sericea</i>		<i>Equisetum arvense</i>	
<i>Populus tremuloides</i>		<i>Viola adunca</i>	
<i>Pseudotsuga menziesii</i>			
<i>Rosa woodsii</i>			

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): *0*  
 % bank length gently sloping (>135°): *75 (average)*  
 % bank length with overhanging vegetation: *50 (conifers)*

BANK CONDITION

	<u>Spring channel</u>	<u>Outside channel</u>
% bank length vegetated, stable:	<i>5</i>	<i>50</i>
% bank length unvegetated, stable:	<i>75</i>	<i>50</i>
% bank length vegetated, unstable:	<i>0</i>	<i>0</i>
% bank length unvegetated, unstable:	<i>20</i>	<i>0</i>

NOTES:

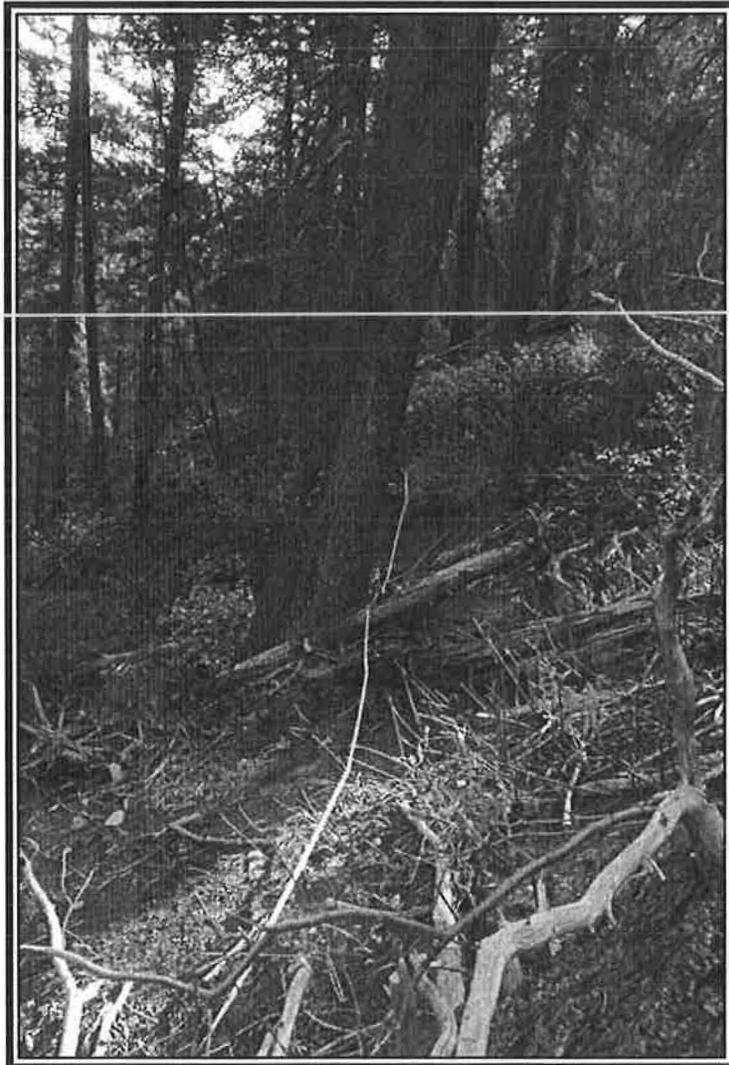
- 1) *This site, also called Wedge Spring, is often measured for flow by a hydrologist.*
- 2) *It had rather low vegetative cover.*
- 3) *No water surfaced here this sample period.*
- 4) *There was less horsetail on the left side with from the previously describe hillside moisture - enough less it may now be considered upland? (Did not). The right side had more dogwood.*
- 5) *The spring was dry.*

## DATA SUMMARY

### Q10S: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2015).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>	0.00		
<i>Conifer</i>		20.00	
<i>Conifer</i>			20.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Cornus sericea/Equisetum arvense</i>		18.00	
<i>Cornus sericea</i>	3.00		
<u>Dominant Herbaceous Species</u>			
<i>Equisetum arvense</i>		22.00	
			43.00
<b>TOTAL COVER (Upland Species)</b>			20.00
<b>TOTAL COVER (Riparian Species)</b>			43.00
<b>ROCK (channel)</b>			7.00
<b>WATER (channel)</b>			0.00
<b>BAREGROUND (channel)</b>			7.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>77.00</b>

## PHOTOGRAPHIC DOCUMENTATION



Q10S

**RIPARIAN COMPLEX DATA SHEET**  
**October 2015**

CLIENT: *Canyon Fuel Company, SUFCO Mine*

SAMPLE NUMBER: *Q11C*

WATERBODY NAME: *South Fork Quitchupah Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *October 1-2, 2015*

OBSERVER(S): *P. Collins, G. McMillan*

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 at site and 2 new beaver dams were built upstream ~ 0.25 mi.*

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)
<i>Abies concolor</i>	<i>Chrysothamnus nauseosus</i>	<i>Trifolium sp.</i>	<i>Agrostis stolonifera</i>
<i>Cornus sericea</i>			<i>Juncus arcticus</i>
<i>Populus tremuloides</i>			<i>Poa pratensis</i>
<i>Pseudotsuga menziesii</i>			
<i>Salix lutea?</i>			

POOL ATTRIBUTES

% area in pools: *80*

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

AQUATIC VEGETATION

% streambed with filamentous algae: *0*

% stream margin with rooted aquatic: *0*

BANK CONDITION

% bank length vegetated, stable: *60*

% bank length unvegetated, stable: *5*

% bank length vegetated, unstable: *5*

% bank length unvegetated, unstable: *25*

NOTES:

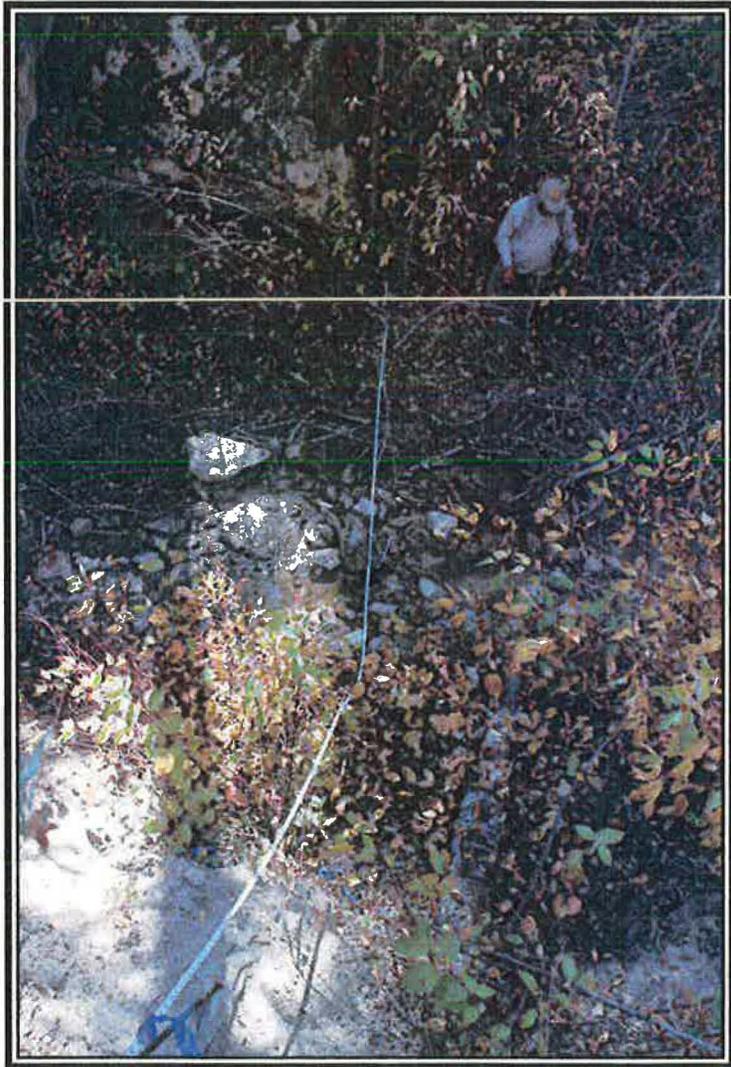
- 1) The plant cover was dogwood.*
- 2) This site was placed at water sampling station (called 006D).*
- 3) There was a rockslide upstream about 0.4 miles (below site 105).*
- 4) The beaver dam upstream had less water in it.*
- 5) The vegetation here fairly looked good.*

## DATA SUMMARY

### Q11C: Cover by plant community types in the South Fork Quitchupah Creek drainage (October 2015).

<u>USDA Forest Service Protocol (1992)</u>			
	LEFT	RIGHT	TOTALS
<b>UPLAND VEGETATION</b>			
<i>Populus tremuloides/Abies concolor</i>	6.00		
<i>Pseudotsuga menziesii</i>		0.00	6.00
<b>RIPARIAN VEGETATION</b>			
<u>Dominant Woody Species</u>			
<i>Cornus sericea</i>	6.00	8.00	
<u>Dominant Herbaceous Species</u>			
			14.00
<b>TOTAL COVER (Upland Species)</b>			6.00
<b>TOTAL COVER (Riparian Species)</b>			14.00
<b>ROCK (channel)</b>			7.00
<b>WATER (channel)</b>			2.00
<b>BAREGROUND (channel)</b>			1.00
<b>LITTER (channel)</b>			0.00
<b>MOSS (channel)</b>			0.00
<b>TOTAL COVER</b>			<b>30.00</b>

PHOTOGRAPHIC DOCUMENTATION



Q11C

RIPARIAN PLANT COMMUNITY  
MONITORING IN SELECTED REACHES OF  
SOUTH FORK QUITCHUPAH CREEK:  
A SUMMARY (2012-2015)

FOR THE  
SUFCO MINE  
SEVIER COUNTY, UTAH



*Prepared by*

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*for*

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SUFCO MINE  
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June 2016



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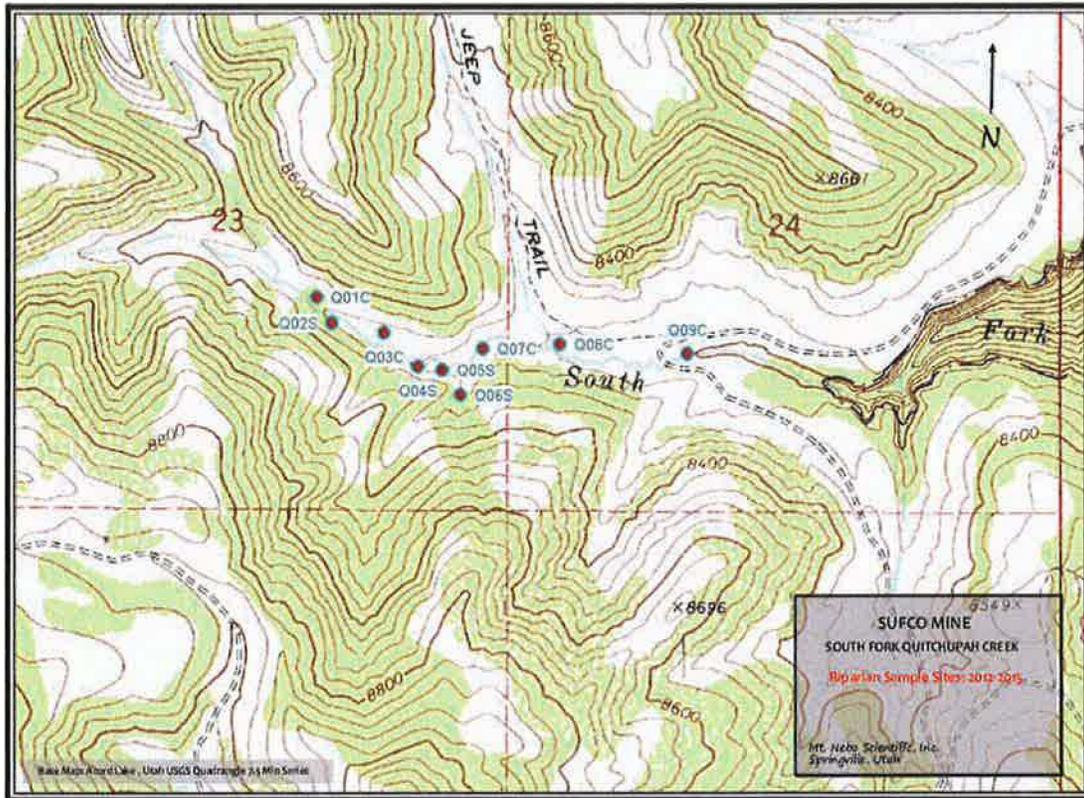
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# INTRODUCTION

The SUFCO coal mine expanded their underground operations adjacent to and below some reaches of the South Fork Quitchupah Creek. Prior to, during, and after mining the riparian vegetation supported along the creek has been monitored for possible impacts that could be caused by mine-related subsidence. This document includes the results of quantitative and qualitative vegetation sampling in several locations within and outside the subsidence zones. Individual reports were prepared previously and submitted to SUFCO for each sample period of each year. This report, however, is a summary of the results of two sample periods per year from 2012 *through* 2015.

## 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 (see map below). 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 riparian sample stations fall between 8,200 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.



### Scope of Study

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 our studies were on vegetation to provide baseline and followup data by monitoring the riparian communities adjacent to South Fork Quitcupah Creek. Regular monitoring was 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, the studies primarily employed vegetation monitoring methods outlined by the USDA Forest Service (described later). The

design of these studies 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 studies were 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

### Field Methods

Sample Station Locations: 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, 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. To accommodate future changes in the mine plan, final sample locations were chosen later, some of which were intentionally placed beyond subsidence zones with the idea that those areas could be used when plans were finalized as “controls”, or areas that would *not* be impacted by mining-related subsidence and could be used as comparisons with those areas that had the potential to be impacted.

Qualitative and quantitative data were recorded at the sample stations along South Fork Quitcupah 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 these studies 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 (including some quantitative data) that have been collected at each sample station.

Photographic stations for documentation and future comparisons have also been established at each sample location.

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 were then 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 topographical features, the intent was to make the transects long enough to cover the entire stream and 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.

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:	

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*. Finally, each sample site was numbered sequentially and by the hydrologic type. For example, **Q01C** refers to the creek name (Quitcupah), station number (01) and hydrologic type (channel). Accordingly, **Q02S** was a spring site rather than a creek channel.

## Data Summaries

To summarize the sample results, riparian vegetation width data of each sample period (July & October) for the sample years (2012-2015) were taken from the previous submitted final reports. The sample periods of each year were then combined to present the data as totals.

# RESULTS

## Sample Stations

The riparian vegetation sample stations in the upper reaches of the South Fork of Quitcupah chosen by the team of experts in the field (as described in the Methods above) that ended up being *outside* the zone of subsidence and therefore used as “controls” were the following:

- Q01C
- Q02S
- Q03C
- Q04S
- Q05S

The upper sample stations located *within* the subsidence zone and were therefore had the potential for impacts from mining included the following:

- Q06S
- Q07C
- Q08C
- Q09C

There are two additional stations where riparian vegetation monitoring began later, or when the mining operations moved into an area on the South Fork of Quitchupah downstream from the above sites. This lower reach sample stations were called Q10S and Q11C. These sites were not included in this report because they may not have had time to stabilize from subsidence and therefore will continue to be monitored in the future.

## Data Separated by Sample Dates

Data from the following sample dates have been summarized for this report:

- August 2012
- October 2012
  
- July 2013
- October 2013
  
- July 2014
- October 2014
  
- July 2015
- October 2015

For comparisons, the total riparian vegetation width of each sample station for the above dates are shown in Table 2.

**TABLE 2: Upper Reaches of South Fork of Quitchupah Creek. Riparian vegetation widths (ft) for each sample period.**

<b>CONTROLS</b>	<b>AUG 2012</b>	<b>OCT 2012</b>	<b>JUL 2013</b>	<b>OCT 2013</b>	<b>JUL 2014</b>	<b>OCT 2014</b>	<b>JUL 2015</b>	<b>OCT 2015</b>
Q01C	8.50	8.50	9.00	6.00	6.00	7.00	10.00	9.00
Q02S	13.00	13.50	7.00	7.00	6.00	7.00	8.00	1.00
Q03C	15.00	14.00	10.50	10.00	9.50	9.00	9.00	9.00
Q04S	26.00	30.00	33.00	20.00	29.00	41.00	47.00	39.00
Q05S	73.00	73.00	72.00	73.00	74.00	73.00	82.00	75.00
<b>SUBSIDENCE ZONE</b>								
Q06S	8.00	8.00	5.00	8.00	8.00	8.00	8.00	8.00
Q07C	33.50	33.50	54.00	54.00	54.00	54.00	54.00	55.00
Q08C	23.00	23.00	22.00	16.00	14.00	16.50	16.50	18.00
Q09C	15.00	14.50	14.00	14.50	12.50	22.00	16.50	14.00

## Data Combined for Each Year

The above separated data is helpful to enable a comparison of the sample data for each month by the year. Another way to look at the data was to combine or “lump” the monthly data of each year. The July dataset for each sample station can be summed with the October data for each year. The total combined widths for each sample station by year are shown on Table 3.

**TABLE 3: Upper Reaches of South Fork of Quitchupah Creek. Total Riparian vegetation widths (ft) for each year (sample periods combined)**

<b>CONTROLS</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>
Q01C	17.00	15.00	13.00	19.00
Q02S	26.50	14.00	13.00	9.00
Q03C	29.00	20.50	18.50	18.00
Q04S	56.00	53.00	70.00	86.00
Q05S	146.00	145.00	147.00	157.00
<b>TOTAL</b>	<b>274.50</b>	<b>247.50</b>	<b>261.50</b>	<b>289.00</b>
<b>SUBSIDENCE ZONE</b>				
	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>
Q06S	16.00	13.00	16.00	16.00
Q07C	67.00	108.00	108.00	109.00
Q08C	46.00	38.00	30.50	34.50
Q09C	29.50	28.50	34.50	30.50
<b>TOTAL</b>	<b>158.50</b>	<b>187.50</b>	<b>189.00</b>	<b>190.00</b>

Fig. 1 shows the combined data for the control stations on a graph that illustrates year-to-year comparisons.

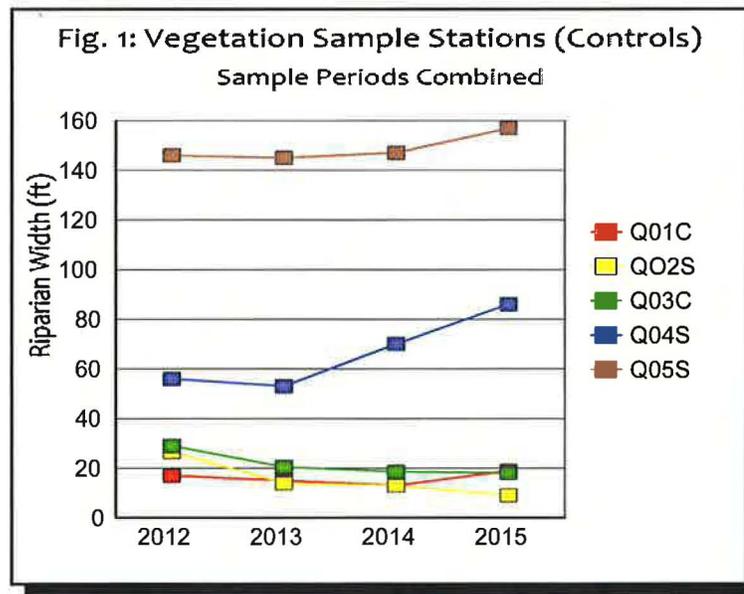
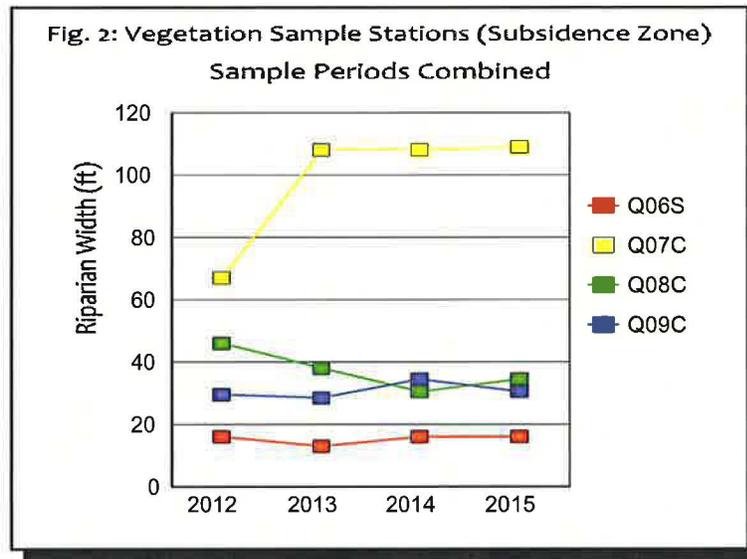


Fig. 2 shows the combined data for the stations in the subsidence zones on a graph that again illustrates year-to-year comparisons at these sites.



## DISCUSSION

As one can see by Table 2 there was not much difference between the early sample period (July) and the later sample period (September) each year. Next, the sample months of each year were summed (Table 3) and these data were graphed according to controls (Fig. 1) and subsidence zones (Fig. 2). For the **controls** there was an upward trend in riparian vegetation width by year for sample stations Q04S and Q05S and a slight downward trend for stations Q01C, Q02S and Q03C. In the **subsidence zones** the results were also mixed. Station Q06S remain relatively consistent for all sample years. Q07C had a sharp increase in riparian community between 2012 and 2013 but remained stable for 2013, 2014 and 2015. Q08C had a downward trend for years 2012, 2013 and 2014, but increased slightly in 2015. Q09C varied from year to year but these changes were probably insignificant because by the last sample year (2015) the riparian vegetation was close to the same as the first sample year (2012).

As suggested above, there seemed to be no clear differences in the riparian width trends for the control stations or the subsidence zone stations. Moreover, there were also no clear

differences in the trends in the springs when compared channel sites in either the control or the subsidence zone stations.

Finally, perhaps the most straightforward way to scrutinize all the data is to sum all riparian widths for all sample stations and compare those values on a year-by-year basis (see TOTALS on Table 3). With this direct comparison, the total riparian vegetation widths increased for the control as well as the subsidence zone sample stations from 2012 to 2015 suggesting that the subsidence from underground coal mining had little or no negative impact on the riparian plant communities that are supported along the South Fork Quitchupah Creek.

Color photographs of the sample stations (July 2015) are shown below. For station photographs of each sample period refer to the individual reports.



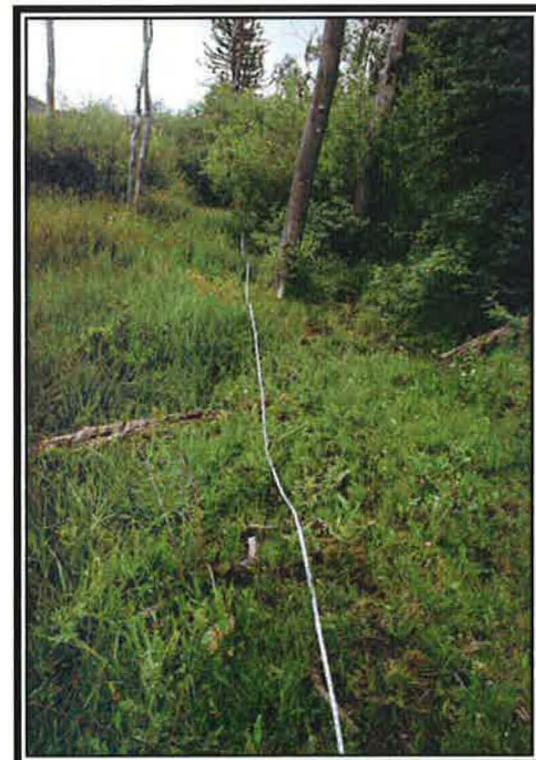
Q01C



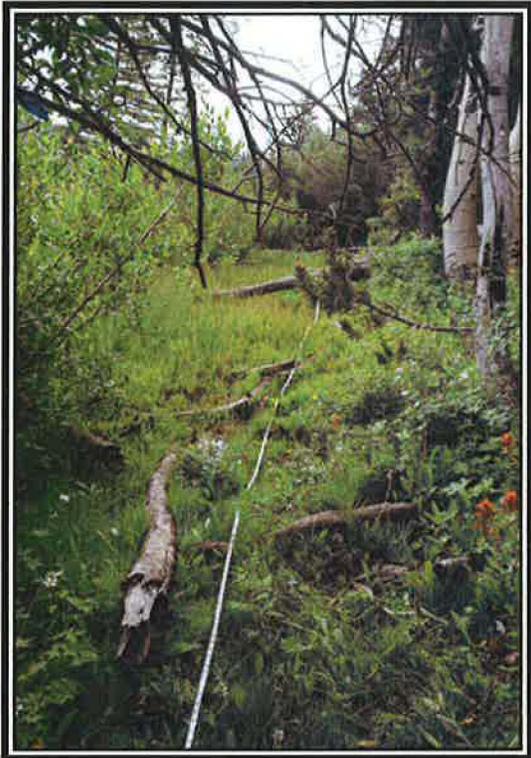
Q02S



Q03C



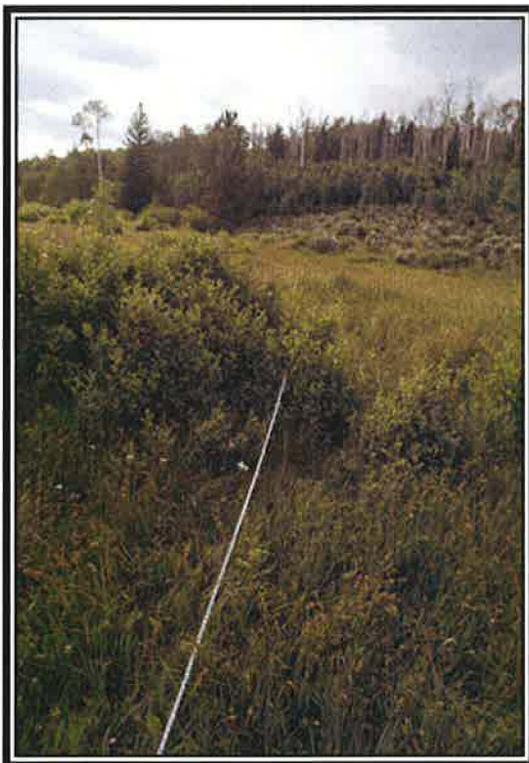
Q04S



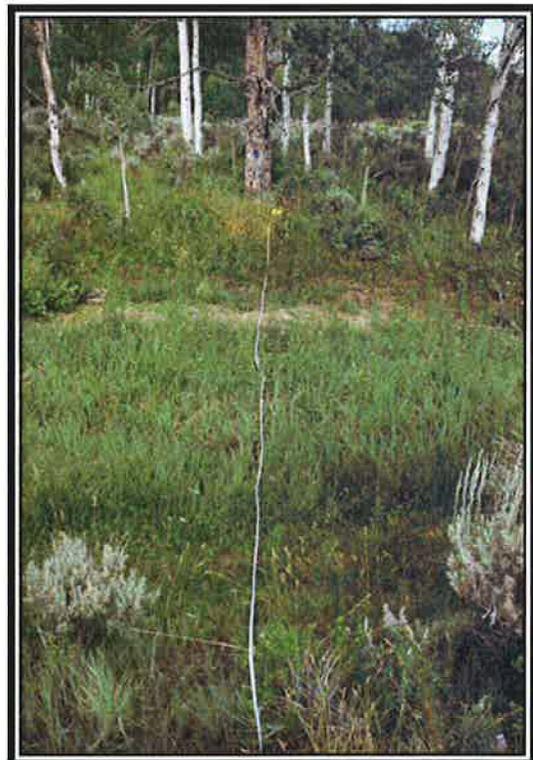
Q05S



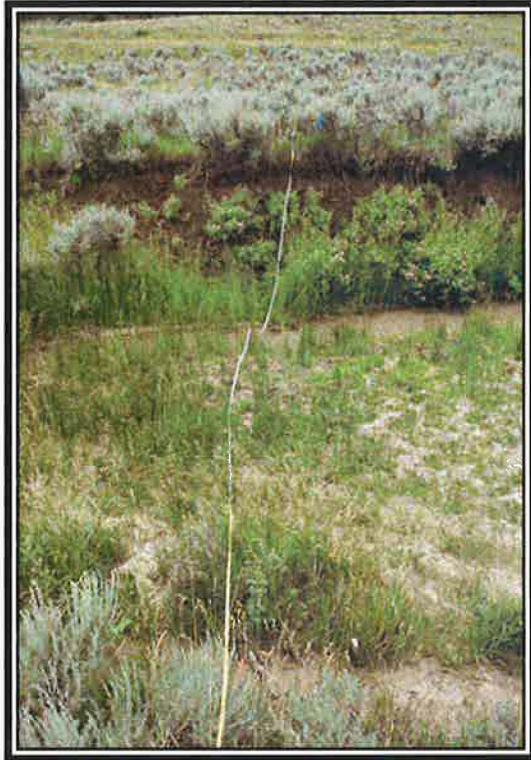
Q06S



Q07C



Q08C



Q09C