

Canyon Fuel Company, LLC
Skyline Mines

2010 Annual Report





Canyon Fuel
Company, LLC.
Skyline Mine

A Subsidiary of Arch Western Bituminous Group, LLC.

Incoming
C0070005

Gregg Galecki, Environmental Eng.
HCR 35, Box 380
Helper, UT 84526
(435) 448-2636 - Office
(435) 448-2632 - Fax

#3786
OK

March 28, 2011

Mr. Daron R. Haddock
Permit Supervisor
Utah Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
Salt Lake City, Utah 84114-5801

RE: 2010 Annual Report, Canyon Fuel Company, LLC, Skyline Mine, C/007/005,

Dear Mr. Haddock:

Please find enclosed with this letter two (2) copies of the 2010 Annual Report. A hard copy of the Annual Report form is included in each binder. An electronic version of the Annual report form was submitted electronically via email earlier today.

If you have any questions, please call me at (435) 448-2636.

Sincerely,

Gregg A. Galecki
Environmental Engineer, Skyline Mine
Canyon Fuel Company, LLC
enclosures

File in:

Confidential

Shelf 2010 Annual Reports

Expandable

Date Folder 03292011 C/0070005

See: Confidential For additional information

RECEIVED

MAR 29 2011

DIV. OF OIL, GAS & MINING

Submit by Email

Print Form

Reset Form

Annual Report

Date

3/22/11

This Annual Report shows information the Division has for your mine. Submit the completed document and any additional information identified in the Appendices to the Division by **March 31, 2011**. During a complete inspection an inspector will check and verify the information.

GENERAL INFORMATION

Company Name Canyon Fuel Company LLC

Mine Name Skyline Mine

Permit Number C/007/0005

Permit expiration Date 2012-04-30

Operator Name Gregg A. Galecki

Phone Number +1 (435) 448-2636

Mailing Address HC 35 Box 380

Email ggalecki@archcoal.com

City Helper

State UT

Zip Code 84526

CERTIFIED REPORTS

DOG M File Location or Annual Report Location

Excess Spoil Piles

- Required
- Not Required

Refuse Piles

- Required
- Not Required

Impoundments

- Required
- Not Required

Other:

1st Qtr emailed 3/11/11; 2nd Qtr-4Qtr submitted electronically 8/5,11/3, and 1/19/11, respectively.

submitted via email 3/10/11

OPERATOR COMMENTS

REVIEWER COMMENTS

Met Requirements

Did Not meet Requirements

RECEIVED
MAR 29 2011

DIV. OF OIL, GAS & MINING

COMMITMENTS AND CONDITIONS

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

Title: Vegetation surveys for Winter Quarters and Woods Stream Channels

Objective: Baseline and monitoring surveys for vegetation along the stream channels

Frequency: Baseline survey of entire length of channels in 2005, monitoring surveys two years prior and during undermining of lengths of channels, and follow-up surveys two years after undermining

Status: Ongoing

Reports: Annual reports

Citation: Vol. A-2 volume 2, Vol. A-3, volume 2.

OPERATOR COMMENTS

Submitted in hard copy - March 2011

REVIEWER COMMENTS

Met Requirements

Did Not meet Requirements

Title: NORTH LEASE VEGETATION SURVEY

Objective: Determine effects of long wall mining on riparian area habitat in comparison with baseline data provided in Appendix A2.

Frequency: Two years prior to and two years after longwall undermining of any section of perennial stream.

Status: ongoing

Reports: Annual

Citation: Volume 1A, Section 2.7, pages 2-61d.

OPERATOR COMMENTS

See Above; submitted in hard copy - March 2011

VIEWER COMMENTS

Met Requirements

Did Not meet Requirements

Title: WASTE ROCK SAMPLING

Objective: To document chemical characteristics and support reclamation plan using less than four feet of cover and to protect surface and groundwater.

Frequency: During periods of deposition at the waste rock site.

Status: Quarterly sampling, 1 sample per 2000 tons hauled to disposal site.

Reports: Annual reporting.

Citation: Vol. 3, Section 4.4, pg. 4-30, 2nd para. And 1988 Soils Guidelines Table 6.

OPERATOR COMMENTS

A total of approximately 6,937 tons of Waste Rock was hauled to the site in 2010. A total of four (4) samples were collected. Hard copies of the lab analysis were submitted to the Division in March 2011.

REVIEWER COMMENTS

Met Requirements

Did Not meet Requirements

Title: FISH SURVEYS

Objective: To determine if mining and mining related activities are impacting the perennial streams located in Woods, Eccles, Burnout and James canyons

Frequency: In the Fall Every three years beginning in 2007

Status: 2007 fall reports complete, next survey due fall 2010 for Eccles and Winter Quarters. Burnout, James, and Woods requirements are complete.

Reports: Annual

Citation: Volume 1A, Section 2.8, page 2-71

OPERATOR COMMENTS

2010 Fish survey for Eccles Creek submitted in hard copy in March 2011. Woods and Winter Quarters survey incorporated into M&RP 2/9/11; Appendix Volume A-3, Volume 2.

REVIEWER COMMENTS

Met Requirements

Did Not meet Requirements

[Redacted]

[Redacted]

Title: North Lease Perennial Stream Flow Measurement.

Objective: Understand the impact of longwall mining on perennial portions of streams in Winter Quarters and Woods Canyons.

Frequency: Monthly, June through October and when accessible, 1 year prior to, during and 1 year after undermining.

Status: Ongoing.

Reports: Quarterly to database -Please submit updates to drawing 2.3.6-2 annually to show the relationship of these monitoring points to the progress of the longwall operation.

Citation: Volume 1a, Page 2-44a, Paragraph 5.

OPERATOR COMMENTS

The As-mined map has been updated and submitted in March 2010. NL sites to be monitored in 2011 include NL-3, NL-5, NL-7, NL-9, NL-15, NL-17, NL-18, NL-24, NL-26, NL-30, and NL-31.

REVIEWER COMMENTS Met Requirements Did Not meet Requirements

[Redacted]

[Redacted]

The following commitments are not required for the current annual report year, but will be required by the permittee in the future as indicated by the Status item. These commitments are included for information only, and do not currently require action.

Title: CULTURAL RESOURCES

Objective: If during the course of mining operations, previously unidentified cultural resources are discovered, the permittee shall ensure that the site(s) is not disturbed and shall notify the Division of Oil, Gas, and Mining. The Division, after coordination with OSM, shall inform the permittee of necessary actions required. The permittee shall implement the mitigation measures required by the Division within the time frame specified by the Division.

Frequency: As needed

Status: Ongoing

Reports: Annual

Citation: Permit Condition Sec. 16

OPERATOR COMMENTS (Optional)

Title: MACROINVERTEBRATE SURVEYS

Objective: To determine if mining and mining related activities are impacting the perennial streams located in Woods, Eccles, Burnout and James canyons

Frequency: Fall and Spring every three years beginning in 2007

Status: 2007 Fall and 2008 Sp reports complete. Next survey due in fall 2011.

Reports: Annual

Citation: Appendix A-3, Volume 2, Volume 1A, Section 2.8, pages 2-71, 71A, B, C, Section 2.8, table 2.8-1a

OPERATOR COMMENTS (Optional)

Table 2.8-1a was modified and incorporated 2/9/11 to change the survey to Spring and Fall 2011.

Title: Topsoil sampling

Objective: To determine fertilizer application rate

Frequency: At final reclamation sample topsoil for N, P, K, Fe, Mg, Mn, Zn, Ca and pH.

Status: Analysis of redistributed topsoil.

Reports: None specified. Suggest verbal communication with Division and lab analysis to be included in bond release application.

Citation: Vol. 3, Section 4.5, pg. 4-32, 2nd para.

OPERATOR COMMENTS (Optional)

No topsoil was re-distributed in 2010.

[Redacted]

Title: SUBSOIL SAMPLING AT WASTE ROCK SITE.

Objective: To provide chemical characteristics of purchased subsoil.

Frequency: Sample purchased subsoil for parameters in Table 1 of the Utah 1988 Guidelines.

Status: Ongoing with contemporaneous reclamation at the waste rock site.

Reports: None specified. Suggest verbal communication with Division and lab analysis to be included in bond release application.

Citation: Vol. 3, Section 4.6.4.1, pg. 4-38a, 3rd para. And pg. 4-38b.

OPERATOR COMMENTS (Optional)

[Redacted]

No topsoil was purchased for the Waste Rock site for contemporaneous reclamation in 2010.

Title: Age-monitoring of Water.

Objective: Understand possible sources of groundwater inflows

Frequency: When inflows of 800 gpm are encountered.

Status: No significant inflows in the North Lease.

Reports: As needed.

Citation: Volume 1, Page 2-35b, Paragraph 2.

OPERATOR COMMENTS (Optional)

[Redacted]

No significant inflows (greater than 800 gpm) were encountered in the North Lease in 2010.

Title: SAMPLING PRIOR TO SLURRY PLACEMENT IN ABANDON UNDERGROUND WORKINGS.

Objective: Protection of groundwater.

Frequency: Every 450 ft. of advance.

Status: Report if placed slurry in abandon underground workings in previous year.

Reports: Notification if parameters are out of compliance with Guidelines for Topsoil and Overburden..

Citation: Volume 2, Incorporation of 97K-1and Section 1.2 (at the end of Section 3.2) and Section 3.2.

OPERATOR COMMENTS (Optional)

[Redacted]

No slurry was place in underground workings in 2010.

Title: SAMPLING OF WASTE ROCK IN TEMPORARY STOCKPILES.

Objective: Protection of surface and groundwater

Frequency: 1 sample/ 2000 tons of temporary stockpiled material

Status: If remains in temporary location longer than three months

Reports: Annual reporting not specified, but assumed to be the same as disposal site sampling (previous paragraph on same page)

Citation: Vol. 3, Section 4.4, pg. 4-30, 3rd para. And 1988 Soils Guidelines Table 6

OPERATOR COMMENTS (Optional)

See Waste Rock Sampling; page 3 of this report.

REPORTING OF OTHER TECHNICAL DATA

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

Please List Attachments:

REVIEWER COMMENTS Met Requirements Did Not meet Requirements

LEGAL, FINANCIAL, COMPLIANCE AND RELATED INFORMATION

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

LEGAL/ FINANCIAL UPDATE

Included

DOGM File Location or Annual Report Location

Officers and Directors	<input type="checkbox"/>	Submitted by V. Miller as Stand-alone Volume "General Chapter 1"
	<input type="checkbox"/>	
	<input type="checkbox"/>	
	<input type="checkbox"/>	

REVIEWER COMMENTS

Met Requirements

Did Not meet Requirements

MAPS

Copies of mine maps, current and up-to-date through at least December 31, 2010, are to be provided to the Division as an attachment to this report in accordance with the requirements of R 645-301-525.240. The map copies shall be made in accordance with 30 CFR 75.1200 as required by MSHA. Mine maps are not considered confidential.

Map Name	Map Number	Included		Confidential	
		Yes	No	Yes	No
Cumulative Subsidence 1982-2010		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Skyline Mine; Mine 3 - Levels 2 and 3; As Mined 2011		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Projected Mining		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

REVIEWER COMMENTS Met Requirements Did Not meet Requirements

OTHER INFORMATION

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

Please List Attachments:

REVIEWER COMMENTS

RIPARIAN PLANT COMMUNITY
MONITORING REPORT FOR
SELECTED REACHES IN
WINTER QUARTERS CANYON
2010

AT THE
SKYLINE MINE
CARBON COUNTY, UTAH



Prepared by

MT. NEBO SCIENTIFIC, INC.

330 East 400 South, Suite 6
Springville, Utah 84663
(801) 489-6937

by

Patrick D. Collins, Ph.D.

for

CANYON FUEL COMPANY, LLC.

Skyline Mines
HC 35 Box 380
Helper, Utah 84526



March 2011

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Introduction

History and Study Objectives

Coal mining activities are currently being conducted at the Skyline Mine in Carbon County, Utah. Some of the mining occurs underneath Winter Quarters Canyon and its tributaries. As a means to monitor impacts from mining to the riparian plant communities supported along the stream-sides in Winter Quarters Canyon, baseline and yearly studies have been, and will continue to be, conducted. This report describes the results for the 2010 monitoring study in the riparian communities there.

The vegetation monitoring studies have been conducted before, during and after the mining operations. The first such study began in 2005 with the objective to provide a comprehensive baseline dataset of representative stream reaches for the *entire area* in Winter Quarters Canyon and Woods Canyon, or those areas that could potentially be impacted by the proposed underground mining activities. The 2005 monitoring year has been called the *Initial Baseline Year* for the riparian studies of the area.

Regular vegetation monitoring in the riparian zones should provide data to determine long-term trends, natural variability and benchmark information including the possible impacts to the riparian plant communities caused by mining under the creeks and streams of the canyons. The studies have been designed so that the sample frequency is intensified in the areas where: 1) underground mining is planned for the near future (for more baseline data), 2) where mining is currently occurring, and 3) where mining has occurred in the

recent past.

The methodologies used in the studies have been consistent for all monitoring periods. They were not designed to provide data that could show *subtle* changes to community structure and species composition as a result of minor changes to the riparian habitat (which can occur as a result of several factors i.e. precipitation changes). Rather, the studies were designed to be compared with future monitoring studies in an attempt to document *major* impacts to the plant communities along the stream due to catastrophic events, such as loss of water and habitat from the effects of subsidence caused from underground mining.

The Study Areas

Winter Quarters Canyon is located within the Wasatch Plateau, a high plateau that lies between the Colorado Plateau and Great Basin regions of the western United States. The canyon is located approximately 3 miles west of the town of Scofield, Utah. The study areas of Winter Quarters Canyon (and Woods Canyon) are located within the Manti-La Sal National Forest.

Geologically, most of the area is Cretaceous in age with formations present that include the Price River, North Horn, and Blackhawk formations. The dominant plant communities of these canyons were riparian, spruce-fir, aspen/grass, sagebrush/grass and mountain herblands.

Methods

Sample Design, Transect Placement & Frequency

The riparian vegetation of specific reaches in Winter Quarters Canyon were sampled in August 2010. Selection of the sample locations of the reaches were based on the underground coal mining schedule of the Skyline Mines. Like 2006 - 2009, the methods for 2010 follow the *Initial Baseline Year (2005)* described above. The riparian vegetation surveys have been designed to concentrate on recently mined areas, current mining, and areas to be mined in the near future. More specifically, the surveys have been conducted where mining activities are planned under the streams according to the following schedule: 1) two years prior to mining specific areas, 2) the year of the mining activities, and 3) two years after mining has occurred in the areas. During these study periods, sampling will be intensified by placing sample stations at regular intervals every 400 ft., rather than the 800 ft. spacing that was used in the *Baseline Year (2005)*.

[NOTE: *In the Initial Baseline Year (2005) sample locations were placed every 800 ft with the exception of those areas that were scheduled to be mined in late-2005, where the 400 ft spacing was used. Because of the spacing differences and because the underground mining progress determines where transects will be placed each year, sometimes the site numbers in each sample area are not in sequential order].*

Line transects were placed at each sample station. Locations and extent of the transects were semi-permanently marked using numbered and flagged wooden stakes and 12-inch metal rods. The vegetation monitoring methods of

the studies have been primarily based on those described by the USDA Forest Service manual for a "Level III Riparian Area Evaluation" (Integrated Riparian Evaluation Guide, March 1992). Qualitative and quantitative data were recorded at the sample stations established in the field. In the first year of the studies, the overall objective of the study plan was to begin monitoring years with one complete baseline dataset for all riparian areas near the perennial streams located in the mine permit area prior to any mining. As mentioned, in the subsequent monitoring years, sample station locations have been determined and mapped based on the time period schedule for the proposed underground mining activities.

Geomorphological stream channel data outlined in the Forest Service protocol were not recorded as part of this study because Canyon Fuel Company has conducted other studies that will suffice for this information. Additionally, soils information through the Natural Resources Conservation Service (NRCS) were not available for the study areas.

TABLE 1: RIPARIAN COMPLEX DATA SHEET	
CLIENT:	
COMPLEX: Riverine - Number	
WATERBODY NAME:	
LOCATION:	
DATE:	
OBSERVER(S):	
QUAD NAME:	
GEOLOGIC PARENT MATERIAL:	
ASPECT:	
STREAM GRADIENT:	
ELEVATION: .	
ADJACENT UPLAND VEGETATION (looking downstream)	
Left:	Right:
VEGETATIVE DESCRIPTION (Dominance by Community Types)	
SUCCESSIONAL STATUS:	
APPARENT FORAGE TREND:	
ESTIMATED FORAGE PRODUCTION:	
BEAVER ACTIVITY:	
PHOTOGRAPH TAKEN:	
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:	

Qualitative Data

The "Riparian Complex Data Sheet" shown on Table 1 lists all of the qualitative and quantitative data that has been, and will continue to be, collected in the future 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

USDA Forest Service protocol was employed as a model to drive the study plan for quantitative data. *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 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 dominates the community by a wide margin, the plant community was

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

Results & Discussion

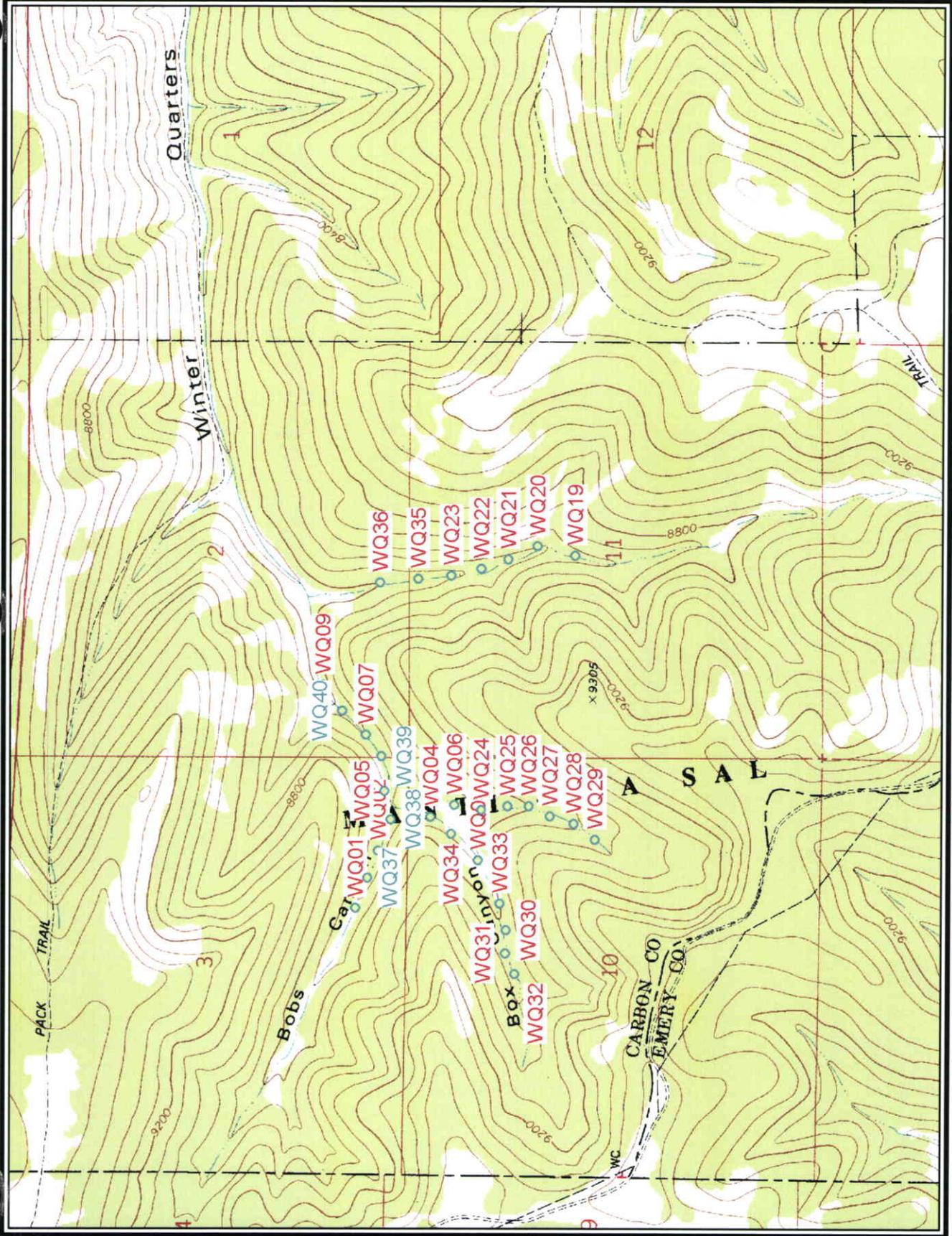
Listed below is a summary of the sample stations for the study areas in 2010 (Table 2). For a map of the locations, refer to the *Sample Station Locations for 2010 in Winter Quarters Canyon* in this report.

TABLE 2: Riparian Sample Stations in Winter Quarters Canyon: 2010

Section 11 Drainage	No-Name Drainage	Box Canyon	Bob's Canyon	WINTER QUARTERS CREEK
WQ-19	WQ-06	WQ-04	WQ-01	WQ-05
WQ-20	WQ-24	WQ-34	WQ-37*	WQ-39*
WQ-21	WQ-25	WQ-03	WQ-02	WQ-07
WQ-22	WQ-26	WQ-33	WQ-38*	WQ-40*
WQ-23	WQ-27	WQ-30		WQ-09
WQ-35	WQ-28	WQ-31		
WQ-36	WQ-29	WQ-32		

* New sample site in 2010

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



Sample Locations for 2010 in Winter Quarters Canyon (Base Map: USGS Scofield, UT 7.5 minute series)

**RIPARIAN COMPLEX DATA SHEET
2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-19

WATERBODY NAME: Winter Quarters Canyon Creek (Section 11 tributary)

LOCATION: Wasatch Plateau, Utah

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: N

STREAM GRADIENT: 1-2 °

ELEVATION: 8,633ft

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen

Right: Spruce/Fir

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Stable

ESTIMATED FORAGE PRODUCTION: 400 lbs/acre

BEAVER ACTIVITY: Historical activity lower in this drainage.

PHOTOGRAPH TAKEN: *Yes*

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>		<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Delphinium barbeyi</i>	<i>Poa secunda</i>
		<i>Epilobium sp.</i>	
		<i>Geranium richardsonii</i>	
		<i>Osmorhiza depauperata</i>	
		<i>Ranunculus cymbalaria</i>	
		<i>Rudbeckia occidentalis</i>	
		<i>Viguiera multiflora</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: 50 (Racy)

BANK TYPE & VEGETATION OVERHANG

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

BANK CONDITION

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

NOTES:

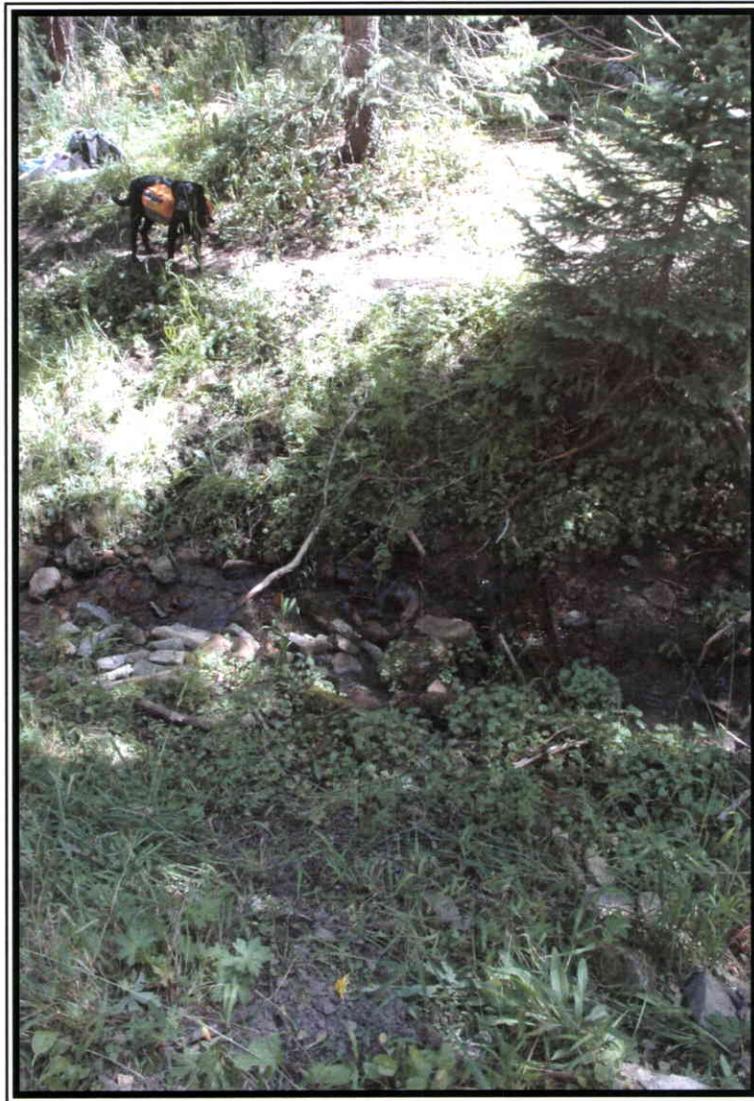
- 1) Site located just upstream from a spring area.
- 2) Placed site upstream from the spring to decrease influence of the stream water.
- 3) Left hillside was sloughing in this area.
- 4) Transect length was 31' in 2006, then to 30' in 2007, 27' in 2008, 27' in 2009, 27' in 2010.
- 5) Good water flow here.

DATA SUMMARY

WQ-19: Cover by community types in Winter Quarters Canyon (2010).

UPLAND VEGETATION	Cover (ft)
	6.00
	7.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera/Ranunculus cymbalaria</i>	9.50
TOTAL COVER (Upland Species)	13.00
TOTAL COVER (Riparian Species)	9.50
ROCK (channel)	1.50
WATER (channel)	3.00
BAREGROUND (channel)	0.00
LITTER	0.00
MOSS	0.00
TOTAL COVER	27.00

PHOTOGRAPHIC DOCUMENTATION



WQ-19

**RIPARIAN COMPLEX DATA SHEET
2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-20

WATERBODY NAME: Winter Quarters Canyon Creek (Section 11 tributary)

LOCATION: Wasatch Plateau, Utah

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: N

STREAM GRADIENT: 1-3 °

ELEVATION: 9000-9500

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Aspen

Right: Aspen/Spruce

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Stable

ESTIMATED FORAGE PRODUCTION: 600 lbs/acre (right side)

BEAVER ACTIVITY: Historical use lower in this drainage

PHOTOGRAPH TAKEN: Yes

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>		<i>Epilobium angustifolium</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Equisetum arvense</i>	<i>Elymus canadensis</i>
		<i>Geranium richardsonii</i>	<i>Carex hoodii</i>
		<i>Rudbeckia occidentalis</i>	
		<i>Senecio serra</i>	
		<i>Thalictrum fendleri</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°):
- % bank length with overhanging vegetation: 5

BANK CONDITION

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

NOTES:

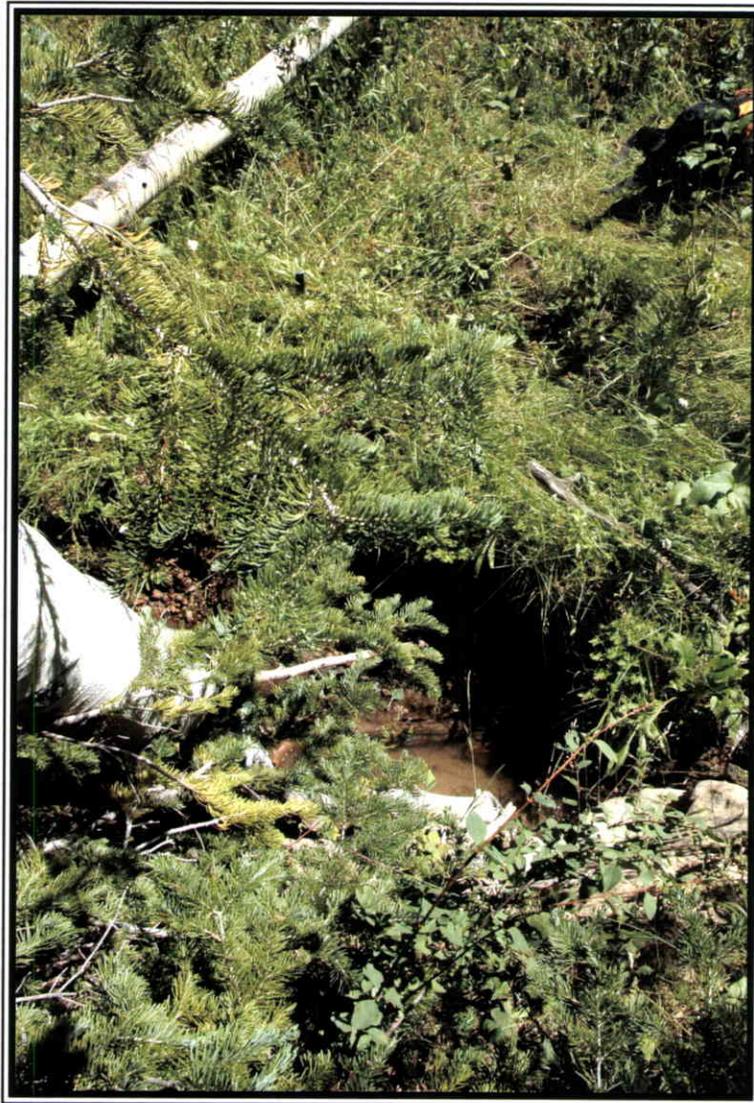
- 1) Right side sloughing from 28' to 15'; some fallen aspen. Not sure what's happening here with the width. It went from 28 ft to 15 ft total width from 2007 to 2008. May have been a measurement error in 2007. Aspen had fallen into spring.
- 2) Checked it again in 2009; it was still 15 ft. (but left marker stake was missing so we put a stake at 15 ft as indicated from the 2008 measurement).
- 3) In 2010 I remarked and staked the riparian area at 33 ft because the existing stake seemed to be in the riparian area (it is now close to original width).
- 4) Noting the BANK CONDITION in 2010 compared to 2009, the bank had evidently stabilized by 2010.

DATA SUMMARY

WQ-20: Cover by community types in Winter Quarters Canyon (2010).

	Cover (ft)
UPLAND VEGETATION	
	5.00
	11.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera/Elymus canadensis</i>	14.00
TOTAL COVER (Upland Species)	16.00
TOTAL COVER (Riparian Species)	14.00
ROCK (channel)	0.00
WATER (channel)	3.00
BAREGROUND (channel)	0.00
LITTER	0.00
MOSS	0.00
TOTAL COVER	33.00

PHOTOGRAPHIC DOCUMENTATION



WQ-20

**RIPARIAN COMPLEX DATA SHEET
2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-21

WATERBODY NAME: Winter Quarters Canyon Creek (Section 11 tributary)

LOCATION: Wasatch Plateau, Utah

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: N

STREAM GRADIENT: 1-3 °

ELEVATION: 8,560 ft

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Open/Spruce/Aspen

Right: Open to Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Stable

ESTIMATED FORAGE PRODUCTION: 600 lbs/acre

BEAVER ACTIVITY: Historical use lower in canyon.

PHOTOGRAPH TAKEN: *Yes*

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Symphoricarpos oreophilus</i>	<i>Aster sp.</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Equisetum arvense</i>	<i>Carex hoodii</i>
		<i>Helianthella uniflora</i>	<i>Elymus canadensis</i>
		<i>Ranunculus cymbalaria</i>	

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

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

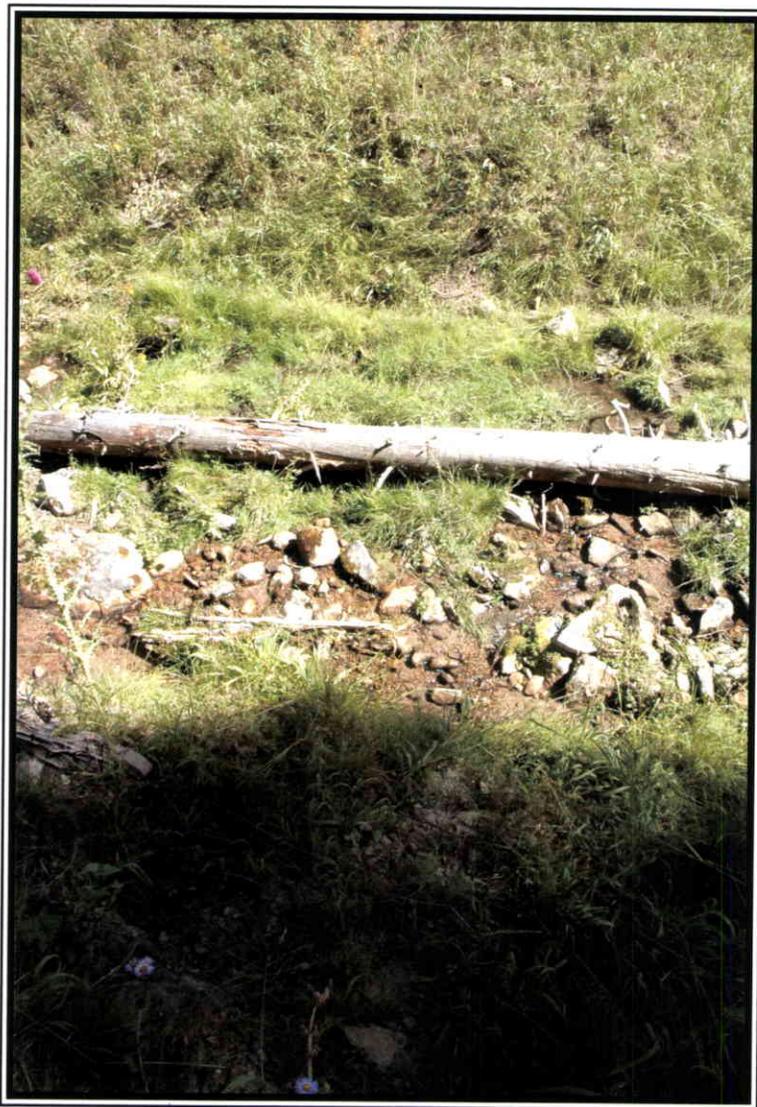
- 1) Good study site - there was an obvious transition from stream riparian to upland.
- 2) The riparian zone here was wider than up- or down-stream.
- 3) Site was located in a flatter area that holds the riparian species well.
- 4) Total transect length measurement has decreased each year, or 37 ft (2006), 36 ft (2007), 35 ft (2008) and 32 ft (2009), 31 ft (2010).
- 5) Logs and litter in stream (see photo).
- 6) Good and constant water flow here.
- 7) Remarkd this site on the GPS.

DATA SUMMARY

WQ-21: Cover by community types in Winter Quarters Canyon (2010).

UPLAND VEGETATION	Cover (ft)
	4.00
	10.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera</i> / <i>Elymus canadensis</i>	9.00
<i>Equisetum arvense</i> / <i>Carex hoodii</i>	5.00
<hr/>	
TOTAL COVER (Upland Species)	14.00
TOTAL COVER (Riparian Species)	14.00
ROCK (channel)	1.00
WATER (channel)	2.00
BAREGROUND (channel)	0.00
LITTER	0.00
MOSS	0.00
<hr/>	
TOTAL COVER	31.00

PHOTOGRAPHIC DOCUMENTATION



WQ-21

**RIPARIAN COMPLEX DATA SHEET
2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-22

WATERBODY NAME: Winter Quarters Canyon Creek (Section 11 tributary)

LOCATION: Wasatch Plateau, Utah

DATE: August 25 - August 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: N

STREAM GRADIENT: 1-3 °

ELEVATION: 8,527 ft

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Aspen

Right: Open to Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Invader species

APPARENT FORAGE TREND: Decreasing

ESTIMATED FORAGE PRODUCTION: 500 lbs/acre

BEAVER ACTIVITY: Historical use lower in canyon

PHOTOGRAPH TAKEN: Yes

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Ribes</i>	<i>Geranium richardsonii</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Senecio serra</i>	<i>Carex hoodii</i>
		<i>Ranunculus cymbalaria</i>	<i>Elymus canadensis</i>
		<i>Urtica dioica</i>	<i>Carex nebrascensis</i>
		<i>Veratrum californicum</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
- % bank length gently sloping (>135°): 100
- % bank length with overhanging vegetation: 5

BANK CONDITION

- % bank length vegetated, stable: 90 on left; 5 on right side; average 45.
- % bank length unvegetated, stable: 5
- % bank length vegetated, unstable: 0
- % bank length unvegetated, unstable: 5 on left; 90 on right; average 45.

NOTES:

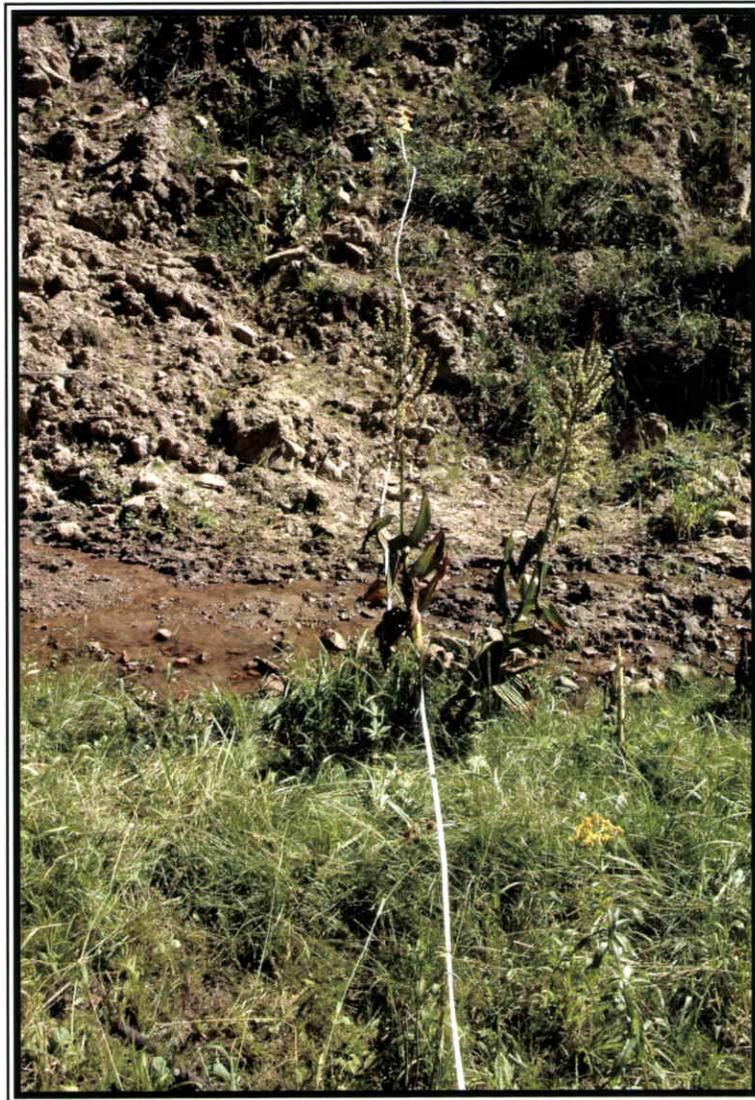
- 1) There was a wide riparian area on the left side.
- 2) It was difficult to tell where the stream water or the hillside water influenced the riparian plants, but I thought the stream had most influence in the area where the riparian cover approached 100%. On the left side, this was an area of about 11' (refer to data).
- 3) There were riparian spp. at higher elevations where I considered it was more upland.
- 4) Right side vegetation was disturbed (taken out) by a slide a few years ago that appears to continue to be active.
- 5) Mud slide took the stake on the right side. We placed a new one in 2009 at the 11 ft distance.
- 6) In 2010 the stake was placed in the slide area at the previous 41 ft distance.
- 7) Beware: We were attacked by wasps from a gray hanging hive at this site in 2008. It was not seen in 2009 or 2010, but wasp attached further downstream in the old spring area (see WQ-36).

DATA SUMMARY

WQ-22: Cover by community types in Winter Quarters Canyon (2010).

UPLAND VEGETATION	Cover (ft)
	3.00
	15.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera/Equisetum</i>	12.00
<hr/>	
TOTAL COVER (Upland Species)	18.00
TOTAL COVER (Riparian Species)	12.00
ROCK (channel)	0.00
WATER (channel)	3.00
BAREGROUND (channel)	8.00
LITTER	0.00
MOSS	0.00
<hr/>	
TOTAL COVER	41.00

PHOTOGRAPHIC DOCUMENTATION



WQ-22

**RIPARIAN COMPLEX DATA SHEET
2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-23

WATERBODY NAME: Winter Quarters Canyon Creek (Section 11 tributary)

LOCATION: Wasatch Plateau, Utah

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: N

STREAM GRADIENT: 1-3^o

ELEVATION: 8,481 ft

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Fir

Right: Open to Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Stable

ESTIMATED FORAGE PRODUCTION: 400 lbs/acre

BEAVER ACTIVITY: Historical use lower in canyon

PHOTOGRAPH TAKEN: *Yes*

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>		<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Geranium richardsonii</i>	<i>Carex hoodii</i>
		<i>Mimulus guttatus</i>	<i>Elymus canadensis</i>
		<i>Ranunculus cymbalaria</i>	
		<i>Senecio serra</i>	
		<i>Urtica dioica</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°): 10
- % bank length with overhanging vegetation: 10

BANK CONDITION

- % bank length vegetated, stable: 80
- % bank length unvegetated, stable: 15
- % bank length vegetated, unstable: 5
- % bank length unvegetated, unstable: 0

NOTES:

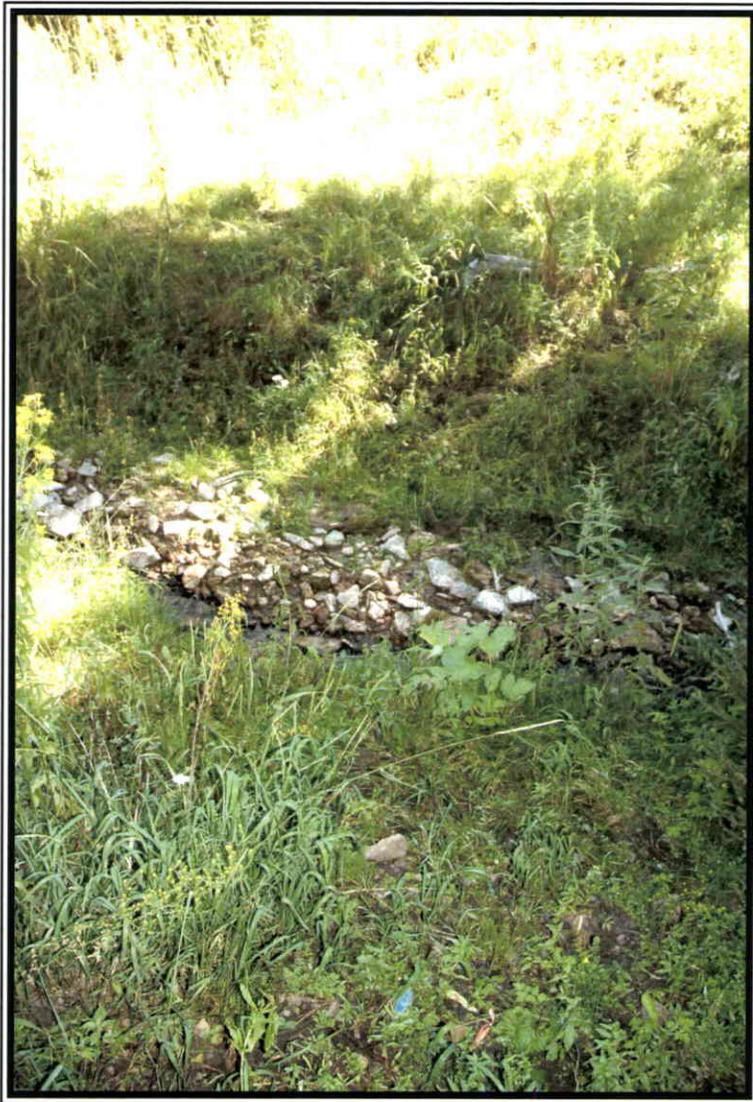
1) On the left side, the upper 3 ft of the riparian zone may be influenced by hillside and stream water.

DATA SUMMARY

WQ-23: Cover by community types in Winter Quarters Canyon (2010).

UPLAND VEGETATION	Cover (ft)
	8.00
	6.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera/Elymus canadensis</i>	11.00
<hr/>	
TOTAL COVER (Upland Species)	14.00
TOTAL COVER (Riparian Species)	11.00
ROCK (channel)	4.00
WATER (channel)	1.00
BAREGROUND (channel)	0.00
LITTER	0.00
MOSS	0.00
<hr/>	
TOTAL COVER	30.00

PHOTOGRAPHIC DOCUMENTATION



WQ-23

**RIPARIAN COMPLEX DATA SHEET
AUGUST 2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-35

WATERBODY NAME: Winter Quarters Canyon Creek (Section 11 tributary)

LOCATION: Southern Wasatch Plateau, Utah

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: north

STREAM GRADIENT: 1-2 °

ELEVATION: ~8478 ft.

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen/Conifer

Right: Conifer

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Stable

ESTIMATED FORAGE PRODUCTION: 500

BEAVER ACTIVITY: none

PHOTOGRAPH TAKEN: Yes

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Ribes sp.</i>	<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Symphoricarpos oreophilus</i>	<i>Delphinium barbeyi</i>	<i>Carex hoodii</i>
		<i>Equisetum arvense</i>	<i>Elymus canadensis</i>
		<i>Geranium richardsonii</i>	<i>Poa pratensis</i>
		<i>Mimulus guttatus</i>	
		<i>Helianthella uniflora</i>	
		<i>Ranunculus cymbalaria</i>	
		<i>Rudbeckia occidentalis</i>	
		<i>Senecio serra</i>	

POOL ATTRIBUTES

% area in pools: 0 (dry, but water surfaced just below this site)

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

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 50

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

% bank length with overhanging vegetation: 25

BANK CONDITION

% bank length vegetated, stable: 80

% bank length unvegetated, stable: 10

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 10

NOTES:

- 1) New sample site in 2008 year.
- 2) Good flat riparian community to monitor on the right site.
- 3) Channel was dry, but water surfaced just below this site.
- 4) Did not find the right stake this year, so it was marked at previous year distance (49 ft).
- 5) The riparian zone was a difficult call on the upper banks due to much *Elymus canadensis*.

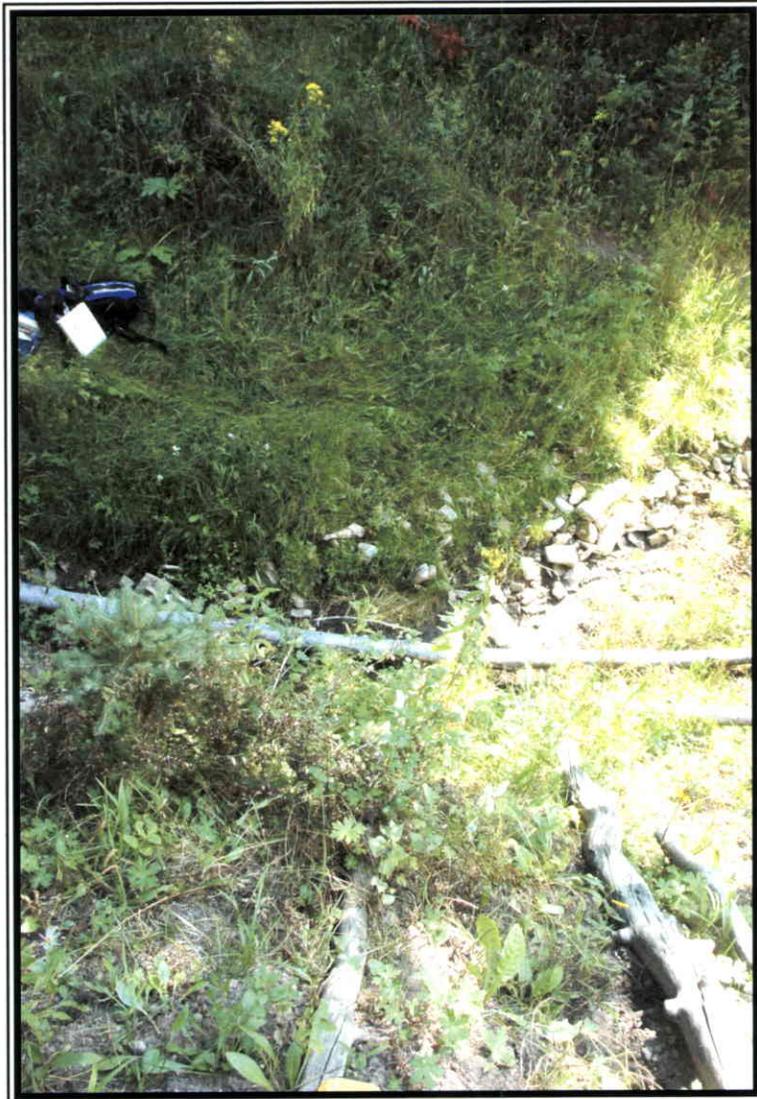
DATA SUMMARY

WQ-35: Cover by community types in Winter Quarters Canyon (2010).

USDA Forest Service Protocol (1992)

UPLAND VEGETATION	9.00
	14.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera</i> / <i>Geranium richardsonii</i>	3.00
<i>Agrostis stolonifera</i> / <i>Elymus canadensis</i>	21.00
<hr/>	
TOTAL COVER (Upland Species)	23.00
TOTAL COVER (Riparian Species)	24.00
ROCK (channel)	1.00
WATER (channel)	0.00
BAREGROUND (channel)	1.00
LITTER	0.00
MOSS	0.00
<hr/>	
TOTAL COVER	49.00
<hr/>	

PHOTOGRAPHIC DOCUMENTATION



WQ-35

**RIPARIAN COMPLEX DATA SHEET
AUGUST 2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-36

WATERBODY NAME: Winter Quarters Canyon Creek (Section 11 tributary)

LOCATION: Southern Wasatch Plateau, Utah

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: north

STREAM GRADIENT: 1-2 °

ELEVATION: 8475 ft

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Conifer

Right: Conifer

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Stable

ESTIMATED FORAGE PRODUCTION: 700

BEAVER ACTIVITY: no

PHOTOGRAPH TAKEN: Yes

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>		<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
		<i>Delphinium barbeyi</i>	<i>Elymus canadensis</i>
		<i>Geranium richardsonii</i>	
		<i>Ranunculus cymbalaria</i>	
		<i>Senecio serra</i>	

POOL ATTRIBUTES

% area in pools: 0 (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°): 25
 % bank length gently sloping (>135°): 75
 % bank length with overhanging vegetation: 50 (herbaceous)

BANK CONDITION

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

NOTES:

- 1) This was a new site for 2008 monitoring.
- 2) There was an especially good riparian community on the left side for monitoring.
- 3) This sample site was somewhat more than the prescribed distance from the last monitoring station because a spring would have made the appropriate distance difficult to accurately monitor. That said, even in this area there could have been some hillside water influence to the riparian community. I would guess it about a 70% chance that this influence existed.
- 4) Unlike 2008 and 2009, there was no water in the channel at this site this year, but the water surfaced ~50 ft downstream.
- 5) Stung by a wasp on the way to this site at 75 ft downstream (marked as waypoint "WQBee" on GPS).

DATA SUMMARY

WQ-36: Cover by community types in Winter Quarters Canyon (2010).

USDA Forest Service Protocol (1992)

UPLAND VEGETATION

11.00
10.00

RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

<i>Agrostis stolonifera/Ranunculus cymbalaria</i>	17.00
<i>Geranium richardsonii</i>	2.00

TOTAL COVER (Upland Species)	21.00
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TOTAL COVER (Riparian Species)	19.00
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ROCK (channel)	0.00
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WATER (channel)	0.00
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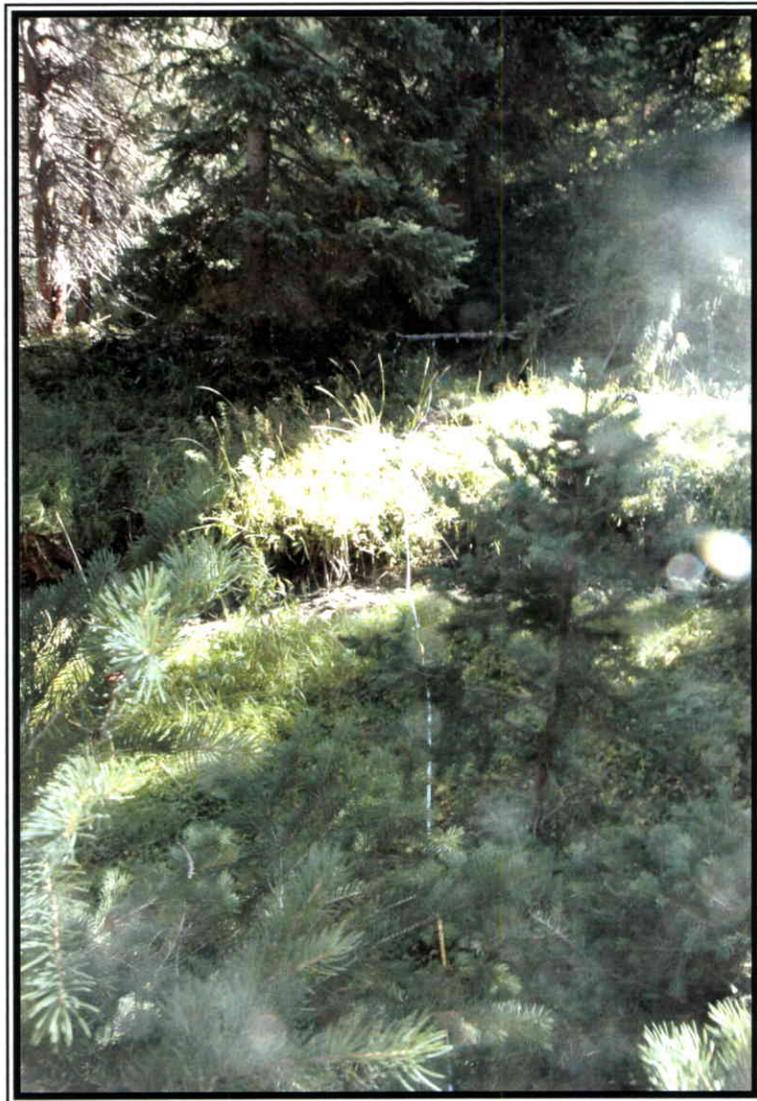
BAREGROUND (channel)	3.50
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LITTER	0.50
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MOSS	0.00
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TOTAL COVER	44.00
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PHOTOGRAPHIC DOCUMENTATION



WQ-36

**RIPARIAN COMPLEX DATA SHEET
2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-06

WATERBODY NAME: Winter Quarters Canyon Creek (Unnamed tributary east of Box Canyon)

LOCATION: Wasatch Plateau, Utah

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: N

STREAM GRADIENT: 1-3 °

ELEVATION: 8,709ft

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Blue Spruce Right: Blue Spruce

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Stable

ESTIMATED FORAGE PRODUCTION: 850 lbs/acre

BEAVER ACTIVITY: No

PHOTOGRAPH TAKEN: Yes

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Lonicera involucrate</i> (young)	<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
	<i>Rosa woodsii</i>	<i>Delphinium barbeyi</i>	<i>Bromus carinatus</i>
		<i>Geranium richardsonii</i>	<i>Elymus canadensis</i>
		<i>Mimulus guttatus</i>	
		<i>Osmorhiza depauperata</i>	
		<i>Ranunculus cymbalaria</i>	
		<i>Rudbeckia occidentalis</i>	

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): 50
- % bank length gently sloping (>135°): 10
- % bank length with overhanging vegetation: 80 (herbaceous)

BANK CONDITION

- % bank length vegetated, stable: 90
- % bank length unvegetated, stable: 0
- % bank length vegetated, unstable: 5
- % bank length unvegetated, unstable: 5

NOTES:

- 1) Good supply of water this year
- 2) The right bank of this site was steep and moisture from the bank may also influence the riparian vegetation.
- 3) The riparian species on the banks were well defined on left visually.
- 4) The right stake was missing in 2009 so it was re-staked using the 2008 measured transect distance (32 ft).
- 5) Distance was 31 ft in 2010 (moved by animals it appeared).

DATA SUMMARY

WQ-06: Cover by community types in Winter Quarters Canyon (2010).	
UPLAND VEGETATION	Cover (ft)
	9.00
	7.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera</i> / <i>Geranium richardsonii</i>	6.50
<i>Agrostis stolonifera</i>	3.00
<i>Ranunculus cymbalaria</i> / <i>Agrostis stolonifera</i>	2.50
TOTAL COVER (Upland Species)	16.00
TOTAL COVER (Riparian Species)	12.00
ROCK (channel)	0.00
WATER (channel)	3.00
BAREGROUND (channel)	0.00
LITTER	0.00
MOSS	0.00
TOTAL COVER	31.00

PHOTOGRAPHIC DOCUMENTATION



WQ-06

**RIPARIAN COMPLEX DATA SHEET
2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-24

WATERBODY NAME: Winter Quarters Canyon Creek (Unnamed tributary east of Box Canyon)

LOCATION: Wasatch Plateau, Utah

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: N

STREAM GRADIENT: 1-3 °

ELEVATION: 8,737 ft

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Grass/Forb (Ruoc)

Right: Grass/Forb (Ruoc)

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Stable

ESTIMATED FORAGE PRODUCTION: 800 lbs/acre

BEAVER ACTIVITY: No

PHOTOGRAPH TAKEN: Yes

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>		<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Geranium richardsonii</i>	<i>Elymus canadensis</i>
		<i>Mimulus guttatus</i>	
		<i>Ranunculus cymbalaria</i>	
		<i>Rudbeckia occidentalis</i>	
		<i>Senecio serra</i>	

POOL ATTRIBUTES

- % area in pools: 50
- % pool area made up of pools > 2' deep: no

AQUATIC VEGETATION

- % streambed with filamentous algae: no
- % stream margin with rooted aquatic: no

BANK TYPE & VEGETATION OVERHANG

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

BANK CONDITION

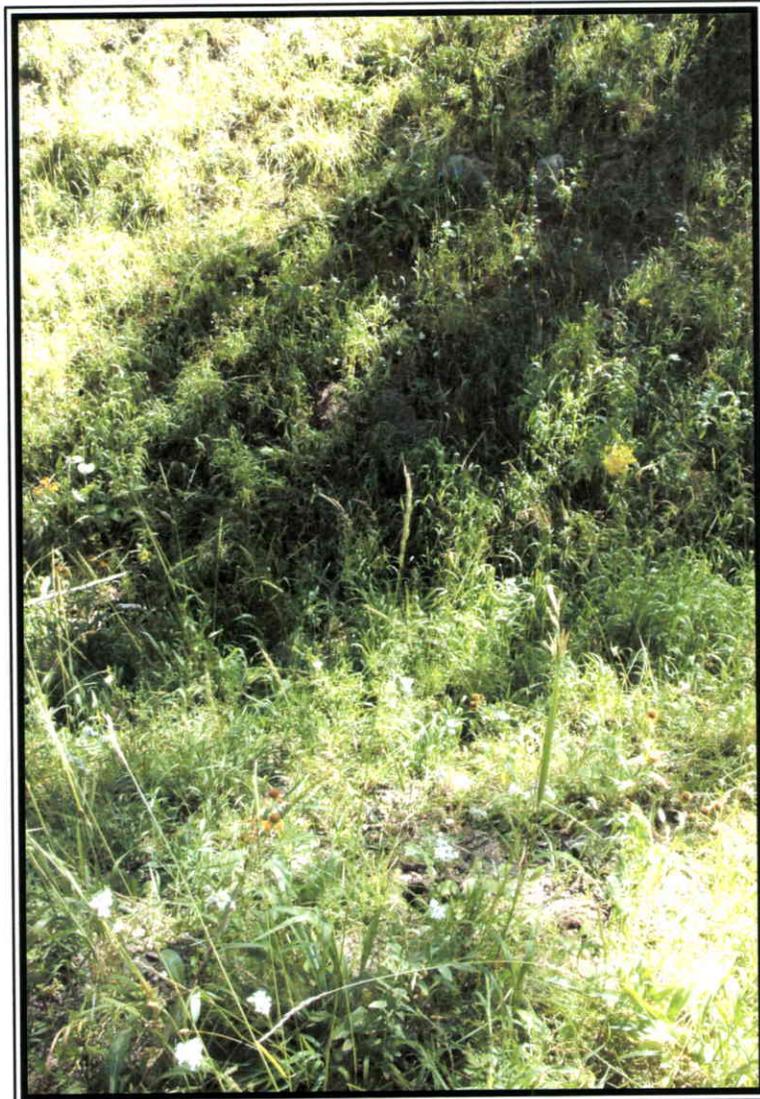
- % bank length vegetated, stable: 90
- % bank length unvegetated, stable: 5
- % bank length vegetated, unstable: 5
- % bank length unvegetated, unstable: 0

NOTES:

DATA SUMMARY

WQ-24: Cover by community types in Winter Quarters Canyon (2010).	
UPLAND VEGETATION	Cover (ft)
	9.50
	9.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera</i> / <i>Elymus canadensis</i>	2.50
<i>Agrostis stolonifera</i>	2.50
TOTAL COVER (Upland Species)	18.50
TOTAL COVER (Riparian Species)	5.00
ROCK (channel)	0.00
WATER (channel)	3.00
BAREGROUND (channel)	0.00
LITTER	0.00
MOSS	0.00
TOTAL COVER	26.50

PHOTOGRAPHIC DOCUMENTATION



WQ-24

**RIPARIAN COMPLEX DATA SHEET
2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-25

WATERBODY NAME: Winter Quarters Canyon Creek (Unnamed tributary east of Box Canyon)

LOCATION: Wasatch Plateau, Utah

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: N

STREAM GRADIENT: 1-3 °

ELEVATION: 8,783 ft

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Fir/Aspen

Right: Spruce/Fir/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Stable

ESTIMATED FORAGE PRODUCTION: 500 lbs/acre

BEAVER ACTIVITY: No

PHOTOGRAPH TAKEN: Yes

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Abies lasiocarpa</i>	<i>Ribes sp.</i>	<i>Geranium richardsonii</i>	<i>Agrostis stolonifera</i>
<i>Picea pungens</i>		<i>Mimulus guttatus</i>	<i>Elymus spicatus</i>
<i>Populus tremuloides</i>		<i>Osmorhiza depauperata</i>	
		<i>Ranunculus cymbalaria</i>	
		<i>Rudbeckia occidentalis</i>	

POOL ATTRIBUTES

- % area in pools: 40
- % pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): 10
- % bank length gently sloping (>135°): 30
- % bank length with overhanging vegetation: 75 (herbaceous)

BANK CONDITION

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

NOTES:

- 1) Good, well-defined river channel.
- 2) Bank slope increases abruptly. Therefore riparian habitat on right.

DATA SUMMARY

WQ-25: Cover by community types in Winter Quarters Canyon (2010).	
UPLAND VEGETATION	Cover (ft)
	10.00
	9.50
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera</i>	6.50
<i>Agrostis stolonifera/Ranunculus cymbalaria</i>	2.00
<hr/>	
TOTAL COVER (Upland Species)	19.50
TOTAL COVER (Riparian Species)	8.50
ROCK (channel)	0.00
WATER (channel)	0.50
BAREGROUND (channel)	0.00
LITTER	0.00
MOSS	0.00
<hr/>	
TOTAL COVER	28.50

PHOTOGRAPHIC DOCUMENTATION



WQ-25

**RIPARIAN COMPLEX DATA SHEET
2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-26

WATERBODY NAME: Winter Quarters Canyon Creek (Unnamed tributary east of Box Canyon)

LOCATION: Wasatch Plateau, Utah

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: N

STREAM GRADIENT: 1-3 °

ELEVATION: 8,804 ft

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Blue Spruce

Right: Grass/Forb

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Stable

ESTIMATED FORAGE PRODUCTION: 800 lbs/acre

BEAVER ACTIVITY: No

PHOTOGRAPH TAKEN: Yes

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Ribes sp.</i>	<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Delphinium nuttallianum</i>	<i>Bromus carinatus</i>
		<i>Geranium richardsonii</i>	<i>Carex hoodii</i>
		<i>Lathyrus lanszwertii</i>	<i>Elymus canadensis</i>
		<i>Mimulus guttatus</i>	<i>Elymus spicatus</i>
		<i>Ranunculus cymbalaria</i>	
		<i>Rudbeckia occidentalis</i>	
		<i>Wyethia amplexicaulis</i>	

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

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

BANK CONDITION

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

NOTES:

DATA SUMMARY

WQ-26: Cover by community types in Winter Quarters Canyon (2010).

UPLAND VEGETATION	6.00
	8.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera</i> / <i>Elymus canadensis</i>	9.50
TOTAL COVER (Upland Species)	14.00
TOTAL COVER (Riparian Species)	9.50
ROCK (channel)	0.00
WATER (channel)	0.50
BAREGROUND (channel)	0.00
LITTER	0.00
MOSS	0.00
TOTAL COVER	24.00

PHOTOGRAPHIC DOCUMENTATION



WQ-26

**RIPARIAN COMPLEX DATA SHEET
2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-27

WATERBODY NAME: Winter Quarters Canyon Creek (Unnamed tributary east of Box Canyon)

LOCATION: Wasatch Plateau, Utah

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: N

STREAM GRADIENT: 1-3 °

ELEVATION: 8,858 ft

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Blue Spruce Right: Herbaceous/Grass

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Stable

ESTIMATED FORAGE PRODUCTION: 900 lbs/acre

BEAVER ACTIVITY: No

PHOTOGRAPH TAKEN: Yes

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>		<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Geranium richardsonii</i>	<i>Elymus canadensis</i>
		<i>Mimulus guttatus</i>	
		<i>Ranunculus cymbalaria</i>	
		<i>Rudbeckia occidentalis</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°): 40
 % bank length gently sloping (>135°): 30
 % bank length with overhanging vegetation: 65 (herbaceous)

BANK CONDITION

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

NOTES:

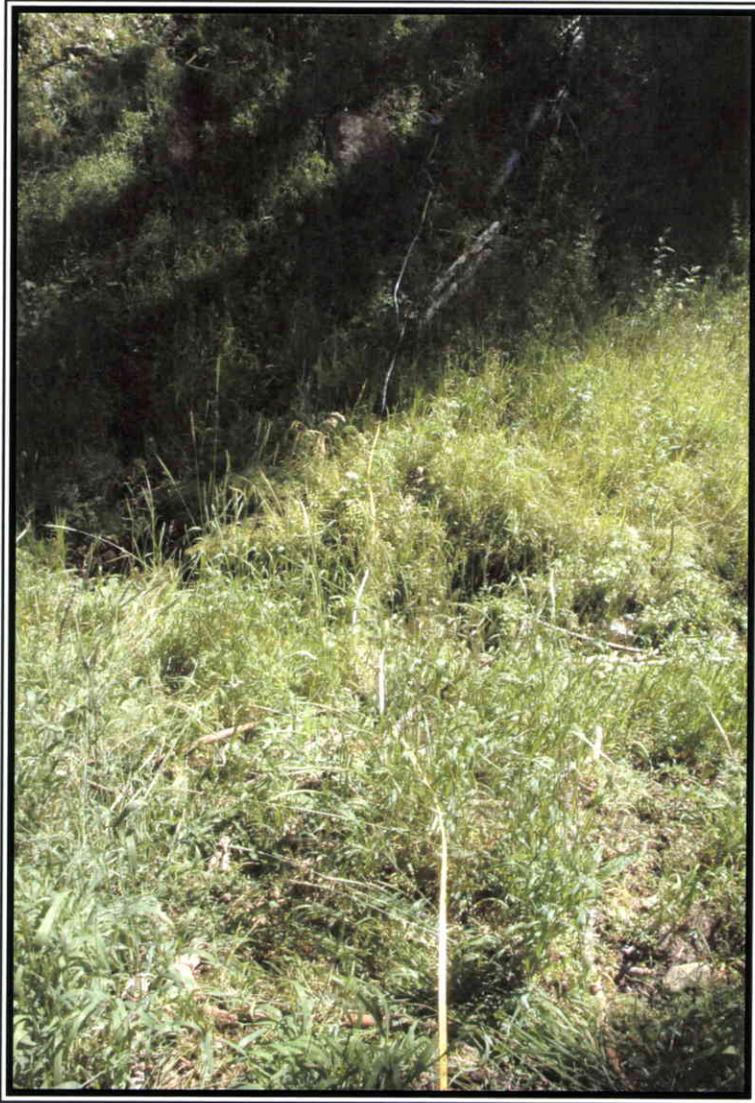
1) Good well-defined flat area with Agst on right side.

DATA SUMMARY

WQ-27: Cover by community types in Winter Quarters Canyon (2010).

UPLAND VEGETATION	Cover (ft)
	10.00
	10.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera</i>	8.00
<i>Agrostis stolonifera/Ranunculus cymbalaria</i>	4.00
<i>Agrostis stolonifera/Elymus canadensis</i>	3.00
TOTAL COVER (Upland Species)	20.00
TOTAL COVER (Riparian Species)	15.00
ROCK (channel)	0.00
WATER (channel)	1.00
BAREGROUND (channel)	0.00
LITTER	0.00
MOSS	0.00
TOTAL COVER	36.00

PHOTOGRAPHIC DOCUMENTATION



WQ-27

**RIPARIAN COMPLEX DATA SHEET
2010**

CLIENT: *Canyon Fuel Company, Skyline Mines*

COMPLEX: Number *WQ-28*

WATERBODY NAME: *Winter Quarters Canyon Creek (Unnamed tributary east of Box Canyon)*

LOCATION: *Wasatch Plateau, Utah*

DATE: *August 25 - 31, 2010*

OBSERVER(S): *P.D. Collins*

QUAD NAME: *Scofield, Utah*

GEOLOGIC PARENT MATERIAL: *Blackhawk Formation*

STEAM ASPECT: *N*

STREAM GRADIENT: *1-3 °*

ELEVATION: *8,879 ft*

SIZE OF COMPLEX: *(see quantitative data)*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: *Conifer/Aspen* Right: *Conifer/Aspen*

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
<i>(refer to quantitative data results for this information)</i>	

SUCCESSIONAL STATUS: *Climax*

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *600 lbs/acre*

BEAVER ACTIVITY: *No*

PHOTOGRAPH TAKEN: Yes

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>		<i>Delphinium barbeyi</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Geranium richardsonii</i>	<i>Avena fatua</i>
		<i>Osmorhiza depauperata</i>	<i>Carex hoodii</i>
		<i>Ranunculus cymbalaria</i>	<i>Poa secunda</i>
		<i>Thalictrum fendleri</i>	
		<i>Veratrum californicum</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°): 50
- % bank length gently sloping (>135°): 50
- % bank length with overhanging vegetation: 75 (herbaceous)

BANK CONDITION

- % bank length vegetated, stable: 75
- % bank length unvegetated, stable: 25
- % bank length vegetated, unstable: 0
- % bank length unvegetated, unstable: 0

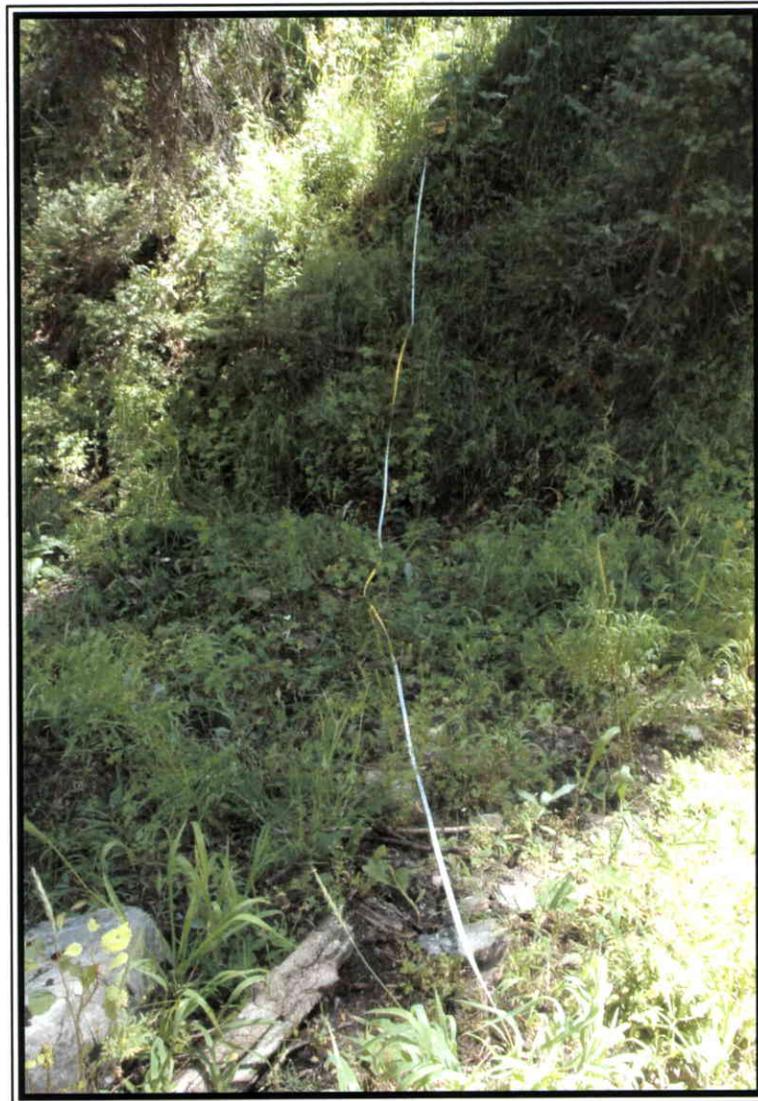
NOTES:

- 1) In 2009 there was good water flow, and did not appear to be decreasing with elevation yet.
- 2) In 2010, there was no flow on this day, rather there was a water pool at site between wet/mud areas.

DATA SUMMARY

WQ-28: Cover by community types in Winter Quarters Canyon (2010).	
UPLAND VEGETATION	Cover (ft)
	10.00
	8.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera/Geranium richardsonii</i>	7.0
TOTAL COVER (Upland Species)	18.00
TOTAL COVER (Riparian Species)	7.00
ROCK (channel)	2.50
WATER (channel)	0.00
BAREGROUND (channel)	0.00
LITTER	0.00
MOSS	0.00
TOTAL COVER	27.50

PHOTOGRAPHIC DOCUMENTATION



WQ-28

**RIPARIAN COMPLEX DATA SHEET
2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-29

WATERBODY NAME: Winter Quarters Canyon Creek (Unnamed tributary east of Box Canyon)

LOCATION: Wasatch Plateau, Utah

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: N

STREAM GRADIENT: 1-3°

ELEVATION: 8,939 ft

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Conifer/Aspen Right: Conifer/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Stable

ESTIMATED FORAGE PRODUCTION: 600 lbs/acre

BEAVER ACTIVITY: No

PHOTOGRAPH TAKEN: *Yes*

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Ribes sp.</i>	<i>Osmorhiza depauperata</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Rudbeckia occidentalis</i>	

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

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

BANK CONDITION

- % bank length vegetated, stable: 80
- % bank length unvegetated, stable: 20
- % bank length vegetated, unstable: 0
- % bank length unvegetated, unstable: 0

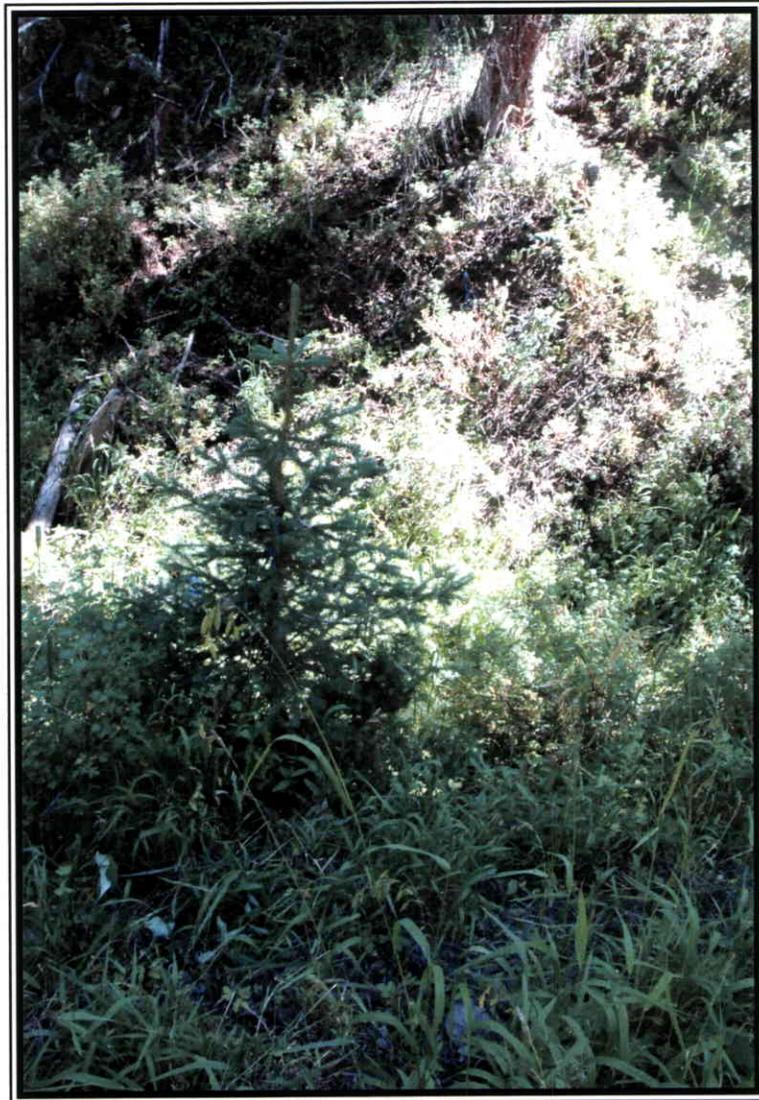
NOTES:

- 1) Most of left bank was called "upland" because the redtop occurring there seemed to be more influenced by side slope moisture.
- 2) Unlike the site below this, there was water flow at this elevation, but it was a very low flow in 2010. There was also flow in 2009.

DATA SUMMARY

WQ-29: Cover by community types in Winter Quarters Canyon (2010).	
UPLAND VEGETATION	Cover (ft)
	10.00
	8.50
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Ranunculus cymbalaria/Agrostis stolonifera</i>	5.00
<i>Agrostis stolonifera</i>	4.00
TOTAL COVER (Upland Species)	18.50
TOTAL COVER (Riparian Species)	8.50
ROCK (channel)	0.00
WATER (channel)	0.50
BAREGROUND (channel)	0.00
LITTER	0.00
MOSS	0.00
TOTAL COVER	27.00

PHOTOGRAPHIC DOCUMENTATION



WQ-29

**RIPARIAN COMPLEX DATA SHEET
AUGUST 2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-04

WATERBODY NAME: Winter Quarters Canyon Creek

LOCATION: Southern Wasatch Plateau, Utah; Lower Box Canyon

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: NE

STREAM GRADIENT: ~2 °

ELEVATION: 8,664 ft

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream):

Left: Aspen/Mtn. Herbland

Right: Blue Spruce/Mtn. Herbland

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Stable

ESTIMATED FORAGE PRODUCTION: 700 lbs/acre

BEAVER ACTIVITY: Historical activity a few hundred feet upstream.

PHOTOGRAPH TAKEN: Yes

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>		<i>Aster sp.</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Geranium richardsonii</i>	<i>Carex hoodii</i>
		<i>Lupinus sp.</i>	<i>Elymus canadensis</i>
		<i>Mimulus guttatus</i>	
		<i>Ranunculus cymbalaria</i>	
		<i>Senecio serra</i>	
		<i>Urtica dioica</i>	
		<i>Viguiera multiflora</i>	

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): 10
- % bank length gently sloping (>135°): 20
- % bank length with overhanging vegetation: 50 (herb.)

BANK CONDITION

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

NOTES:

- 1) This site is approx. midway between main channel and upper Box Canyon sample point.
- 2) In 2009, we were not sure why there was more riparian width here compared to 2005; the 2010 measurement was similar to 2009.
- 3) Left stake was displaced in 2009 and it was re-staked on this side using the 2008 measured transect distance (27 ft); in 2010 it was 27 ft.

DATA SUMMARY

WQ04: Cover by community types in Winter Quarters Canyon (2010).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION

8.00
 9.00

RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

Agrostis stolonifera/Elymus canadensis 5.00

TOTAL COVER (Upland Species) 17.00

TOTAL COVER (Riparian Species) 5.00

ROCK (channel) 2.50

WATER (channel) 2.50

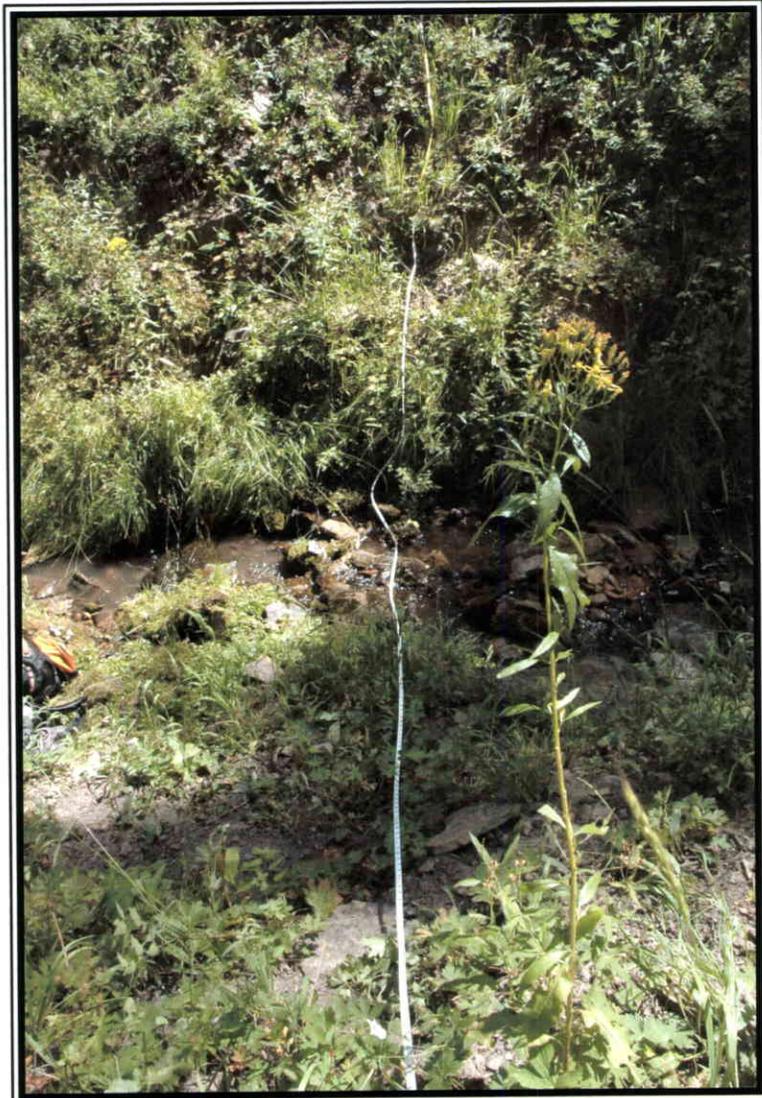
BAREGROUND (channel) 0.00

LITTER 0.00

MOSS 0.00

TOTAL COVER **27.00**

PHOTOGRAPHIC DOCUMENTATION



WQ-04

**RIPARIAN COMPLEX DATA SHEET
AUGUST 2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-34

WATERBODY NAME: Winter Quarters Canyon Creek; upper Box Canyon

LOCATION: Southern Wasatch Plateau, Utah; upper Box Canyon

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: ENE

STREAM GRADIENT: 2°

ELEVATION: 8,729 ft.

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Mtn. Herbland/Conifer

Right: Mtn. Herbland/Conifer

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Stable

ESTIMATED FORAGE PRODUCTION: 800 lbs./acre

BEAVER ACTIVITY: see Notes

PHOTOGRAPH TAKEN: Yes

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Abies lasiocarpa</i>	<i>Ribes sp.</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
		<i>Geranium richardsonii</i>	<i>Carex nebrascensis</i>
		<i>Senecio serra</i>	<i>Elymus canadensis</i>
			<i>Phleum pratensis</i>

POOL ATTRIBUTES

- % area in pools: 20
- % pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): 40
- % bank length gently sloping (>135°): 0
- % bank length with overhanging vegetation: 90 (herbaceous)

BANK CONDITION

- % bank length vegetated, stable: 80
- % bank length unvegetated, stable: 10
- % bank length vegetated, unstable: 5
- % bank length unvegetated, unstable: 5

NOTES:

- 1) This site was a new sample station in 2008.
- 2) Left side riparian community was sloughing, perhaps from animal use.

DATA SUMMARY

WQ-34: Cover by community types in Winter Quarters Canyon (2010).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
	10.00
	12.00
 RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
 <u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera/Equisetum arvense</i>	9.00
<hr/>	
TOTAL COVER (Upland Species)	22.00
TOTAL COVER (Riparian Species)	9.00
ROCK (channel)	0.00
WATER (channel)	2.00
BAREGROUND (channel)	0.00
LITTER	0.00
MOSS	0.00
<hr/>	
TOTAL COVER	33.00

PHOTOGRAPHIC DOCUMENTATION



WQ-34

**RIPARIAN COMPLEX DATA SHEET
2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-03

WATERBODY NAME: Winter Quarters Canyon Creek; upper Box Canyon

LOCATION: Southern Wasatch Plateau, Utah; upper Box Canyon

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STREAM ASPECT: ENE

STREAM GRADIENT: 2°

ELEVATION: 8,729 ft.

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Mtn. Herbland

Right: Mtn. Herbland

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Increasing

ESTIMATED FORAGE PRODUCTION: 1500 lbs./acre

BEAVER ACTIVITY: see Notes

PHOTOGRAPH TAKEN: Yes

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>		<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Helianthella uniflora</i>	<i>Carex nebrascensis</i>
		<i>Senecio serra</i>	<i>Carex hoodii</i>
		<i>Viguiera multiflora</i>	<i>Juncus longistylis</i>

POOL ATTRIBUTES

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

AQUATIC VEGETATION

- % streambed with filamentous algae: 0
- % stream margin with rooted aquatic: 50 (much of the stream had rooted vegetation)

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): 30
- % bank length gently sloping (>135°): 0
- % bank length with overhanging vegetation: 95

BANK CONDITION

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

NOTES:

- 1) This site was approx. 400 ft upstream frm a very old beaver dam.
- 2) There was very little water at the site - about 12 inches wide.
- 3) This site's elev. may be too high to always observe water. This appears to be a fair water year; there may be no water here in lower prec. years.
- 4) The adjacent areas were open areas (Mtn. Herblands)
- 5) Right side stake was missing; it was replaced at the 2009 transect distance.
- 6) I collected a *Carex* sp. this year (After collection review, I called it *C. hoodii*).

DATA SUMMARY

**WQ-03: Cover by community types in Winter Quarters Canyon
 (2010).**

USDA Forest Service Protocol (1992)

UPLAND VEGETATION	9.00
	10.00

RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

<i>Agrostis stolonifera/Carex hoodii</i>	11.50
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TOTAL COVER (Upland Species)	19.00
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TOTAL COVER (Riparian Species)	11.50
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ROCK (channel)	0.00
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WATER (channel)	0.50
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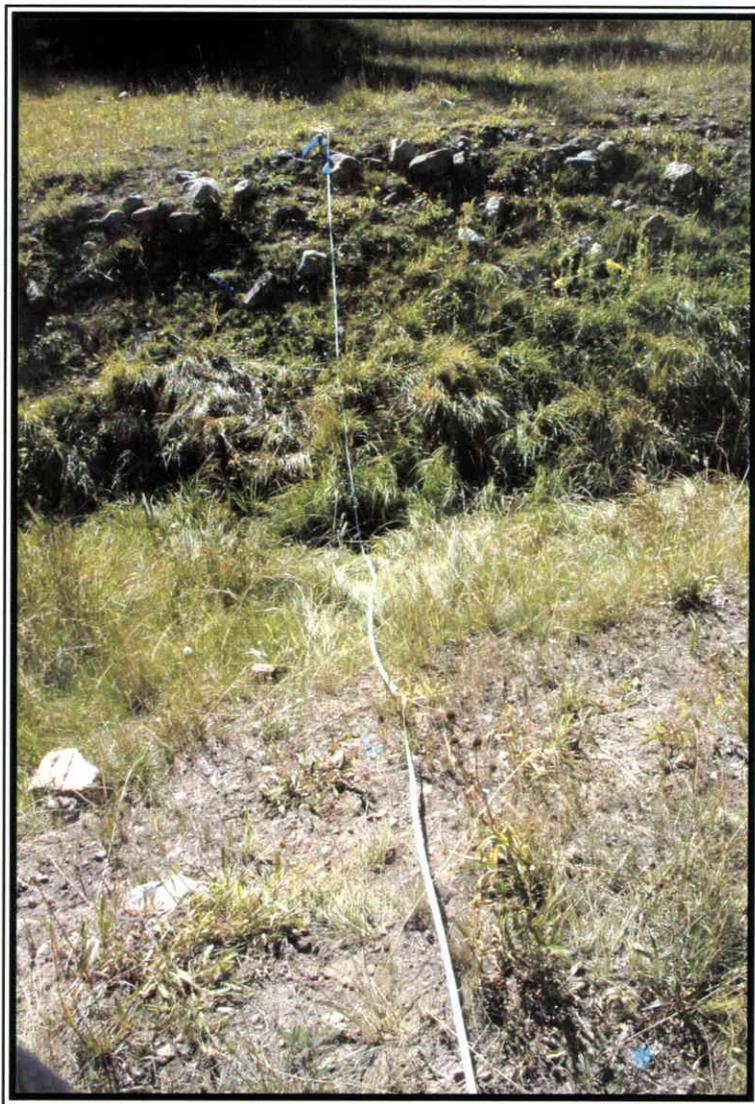
BAREGROUND (channel)	0.00
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LITTER	0.00
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MOSS	0.00
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<u>TOTAL COVER</u>	<u>31.00</u>
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PHOTOGRAPHIC DOCUMENTATION



WQ-03

**RIPARIAN COMPLEX DATA SHEET
AUGUST 2010**

CLIENT: *Canyon Fuel Company, Skyline Mines*

COMPLEX: *Number WQ-33*

WATERBODY NAME: *Winter Quarters Canyon Creek*

LOCATION: *Southern Wasatch Plateau, Utah*

DATE: *August 25 - 31, 2010*

OBSERVER(S): *P.D. Collins*

QUAD NAME: *Scofield, Utah*

GEOLOGIC PARENT MATERIAL: *Blackhawk Formation*

STEAM ASPECT: *N*

STREAM GRADIENT: *1-2 °*

ELEVATION: *8769 ft*

SIZE OF COMPLEX: *(see quantitative data)*

ADJACENT UPLAND VEGETATION (looking downstream)

Left: *Mtn Grassland/Conifer*

Right: *Mtn Grassland/Conifer*

VEGETATIVE DESCRIPTION (Dominance by Community Types):

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

SUCCESSIONAL STATUS: *Climax*

APPARENT FORAGE TREND: *Stable*

ESTIMATED FORAGE PRODUCTION: *600 lbs./ac*

BEAVER ACTIVITY: *Several beaver ponds located below this site.*

PHOTOGRAPH TAKEN: *Yes*

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Symphoricarpos oreophilus</i>	<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Lupinus sp.</i>	<i>Elymus canadensis</i>
<i>Sambucus caerulea</i>		<i>Rudbeckia occidentalis</i>	
		<i>Taraxacum officinale</i>	

POOL ATTRIBUTES

% area in pools: 50 (100% at transect line)

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

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 30

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

% bank length with overhanging vegetation: 20 (herbaceous)

BANK CONDITION

% bank length vegetated, stable: 75

% bank length unvegetated, stable: 20

% bank length vegetated, unstable: 3

% bank length unvegetated, unstable: 2

NOTES:

- 1) This is a new sample location for 2008.
- 2) There was lots of beaver influence below this site.

DATA SUMMARY

WQ- 33: Cover by community types in Winter Quarters Canyon (2010).

USDA Forest Service Protocol (1992)

UPLAND VEGETATION

12.00
10.00

RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

Agrostis stolonifera/Elymus canadensis

2.00

Elymus canadensis

4.00

TOTAL COVER (Upland Species)

22.00

TOTAL COVER (Riparian Species)

6.00

ROCK (channel)

0.00

WATER (channel)

5.00

BAREGROUND (channel)

0.00

LITTER

0.00

MOSS

0.00

TOTAL COVER

33.00

PHOTOGRAPHIC DOCUMENTATION



WQ-33

**RIPARIAN COMPLEX DATA SHEET
2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-30

WATERBODY NAME: Winter Quarters Canyon Creek (Box Canyon)

LOCATION: Wasatch Plateau, Utah

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: ENE

STREAM GRADIENT: 1-3 °

ELEVATION: 8,856 ft

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen/Conifer

Right: Conifer

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Stable

ESTIMATED FORAGE PRODUCTION: 1000 lbs/acre

BEAVER ACTIVITY: No

PHOTOGRAPH TAKEN: *Yes*

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Ribes sp.</i>	<i>Geranium richardsonii</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Helianthella uniflora</i>	<i>Carex hoodii</i>
		<i>Lathyrus lanszwertii</i>	<i>Elymus canadensis</i>
		<i>Ranunculus cymbalaria</i>	
		<i>Urtica dioica</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°): 60
- % bank length gently sloping (>135°): 10
- % bank length with overhanging vegetation: 95 (shrubs & herbs)

BANK CONDITION

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

NOTES:

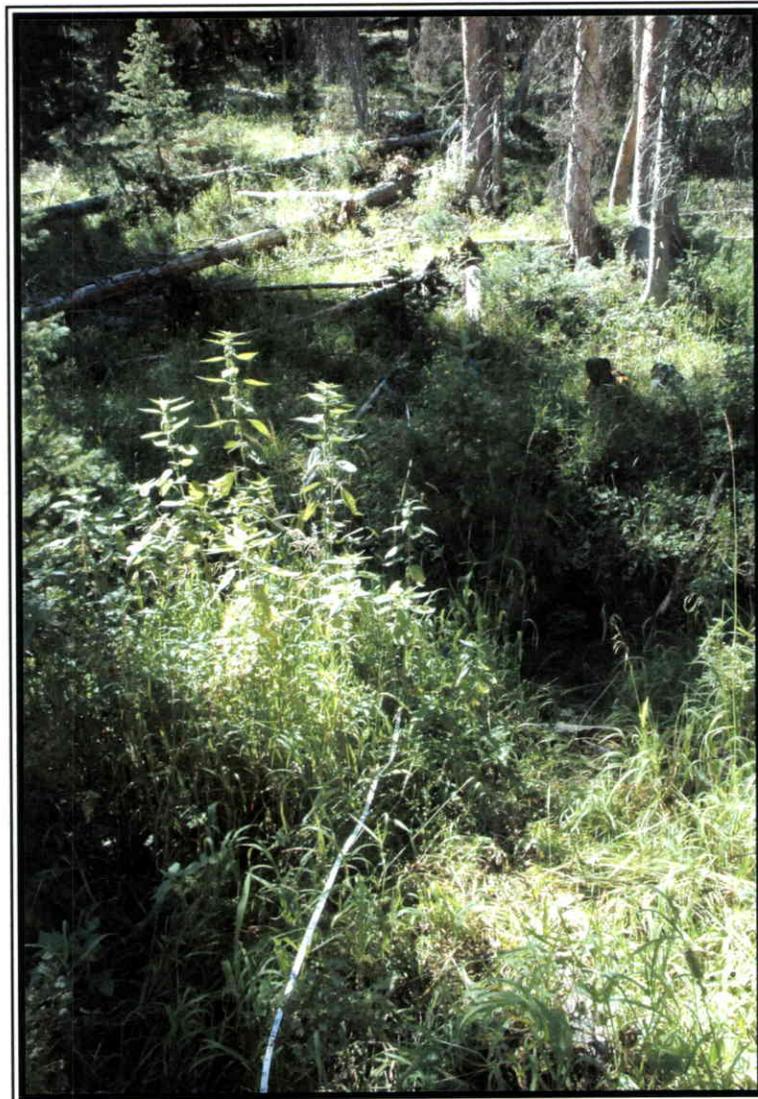
- 1) There was a lot of water here with 4 ft wide pools.

DATA SUMMARY

WQ-30 Cover by community types in Winter Quarters Canyon (2010).

UPLAND VEGETATION	Cover (ft)
	7.00
	6.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera/Elymus canadensis</i>	4.00
<i>Ranunculus cymbalaria</i>	3.00
<i>Agrostis stolonifera/Carex hoodii</i>	5.00
<hr/>	
TOTAL COVER (Upland Species)	13.00
TOTAL COVER (Riparian Species)	12.00
ROCK (channel)	1.00
WATER (channel)	1.50
BAREGROUND (channel)	0.00
LITTER	0.50
MOSS	0.00
<hr/>	
TOTAL COVER	28.00

PHOTOGRAPHIC DOCUMENTATION



WQ-30

**RIPARIAN COMPLEX DATA SHEET
2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-31

WATERBODY NAME: Winter Quarters Canyon Creek (Box Canyon)

LOCATION: Wasatch Plateau, Utah

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: ENE

STREAM GRADIENT: 1-3^o

ELEVATION: 8,868 ft

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen

Right: Conifer

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Stable

ESTIMATED FORAGE PRODUCTION: 600 lbs/acre

BEAVER ACTIVITY: No

PHOTOGRAPH TAKEN: *Yes*

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Abies lasiocarpa</i>	<i>Symphoricarpos oreophilus</i>	<i>Arnica cordifolia</i>	<i>Agrostis stolonifera</i>
<i>Picea pungens</i>		<i>Equisetum arvensis</i>	<i>Calamagrostis canadensis</i>
<i>Populus tremuloides</i>		<i>Geranium richardsonii</i>	<i>Juncus longistylis</i>
		<i>Ranunculus cymbalaria</i>	<i>Carex hoodii</i>
		<i>Rudbeckia occidentalis</i>	

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

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

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 was a good sample site because the riparian and upland zones were obvious.
- 2) There was no ambiguity about what water was influencing the riparian zone - it was the stream water, not the side-slope ground moisture.
- 3) As mentioned in 2009 only, the left upland slope appeared unstable.

DATA SUMMARY

WQ-31: Cover by community types in Winter Quarters Canyon (2010).

UPLAND VEGETATION	Cover (ft)
	10.00
	8.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Elymus canadensis</i>	1.00
<i>Agrostis canadensis/Carex hoodii</i>	5.00
TOTAL COVER (Upland Species)	18.00
TOTAL COVER (Riparian Species)	6.00
ROCK (channel)	0.00
WATER (channel)	2.00
BAREGROUND (channel)	0.00
LITTER	0.00
MOSS	0.00
TOTAL COVER	26.00

PHOTOGRAPHIC DOCUMENTATION



WQ-31

**RIPARIAN COMPLEX DATA SHEET
2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-32

WATERBODY NAME: Winter Quarters Canyon Creek (Box Canyon)

LOCATION: Wasatch Plateau, Utah

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: ENE

STREAM GRADIENT: 1-3 °

ELEVATION: 8,870 ft

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Grass/Forb Right: Aspen/Conifer

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Stable

ESTIMATED FORAGE PRODUCTION: 1100 lbs/acre

BEAVER ACTIVITY: No

PHOTOGRAPH TAKEN: Yes

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>		<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Equisetum arvensis</i>	<i>Elymus canadensis</i>
		<i>Geranium richardsonii</i>	
		<i>Mimulus guttatus</i>	
		<i>Rudbeckia occidentalis</i>	
		<i>Urtica dioica</i>	
		<i>Viguiera multiflora</i>	

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

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

BANK CONDITION

% bank length vegetated, stable: 100
 % bank length unvegetated, stable: 0
 % bank length vegetated, unstable: 0
 % bank length unvegetated, unstable: 0

NOTES:

- 1) Good well-defined riparian zone.
- 2) Good water flow; flow also continues from upper canyon reaches.
- 3) It was thought that the riparian zone and sampling locations were well-represented in Box Canyon, so more sampling upstream was not done.

DATA SUMMARY

WQ-32: Cover by community types in Winter Quarters Canyon (2010).	
UPLAND VEGETATION	Cover (ft)
	10.00
	10.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera/Elymus canadensis</i>	10.50
TOTAL COVER (Upland Species)	20.00
TOTAL COVER (Riparian Species)	10.50
ROCK (channel)	0.00
WATER (channel)	1.50
BAREGROUND (channel)	0.00
LITTER	0.00
MOSS	0.00
TOTAL COVER	32.00

PHOTOGRAPHIC DOCUMENTATION



WQ-32

**RIPARIAN COMPLEX DATA SHEET
2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-01

WATERBODY NAME: Winter Quarters Canyon Creek

LOCATION: Wasatch Plateau, Utah

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: E

STREAM GRADIENT: 1-2 °

ELEVATION: 8,656ft

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen

Right: Conifer

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Stable

ESTIMATED FORAGE PRODUCTION: 800 lbs/acre

BEAVER ACTIVITY:

PHOTOGRAPH TAKEN: Yes

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Symphoricarpos oreophilus</i>	<i>Achillea millefolium</i>	<i>Carex hoodii</i>
		<i>Aster sp.</i>	<i>Elymus canadensis</i>
		<i>Polygonum sp.</i>	<i>Agrostis stolonifera</i>
		<i>Ranunculus cymbalaria</i>	
		<i>Senecio serra</i>	
		<i>Urtica dioica</i>	
		<i>Veratrum californicum</i>	

POOL ATTRIBUTES

- % area in pools: 5
- % pool area made up of pools > 2' deep:

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°):
- % bank length gently sloping (>135°): 50% on left side only
- % bank length with overhanging vegetation: Right side 100%; left side 60%.

BANK CONDITION

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

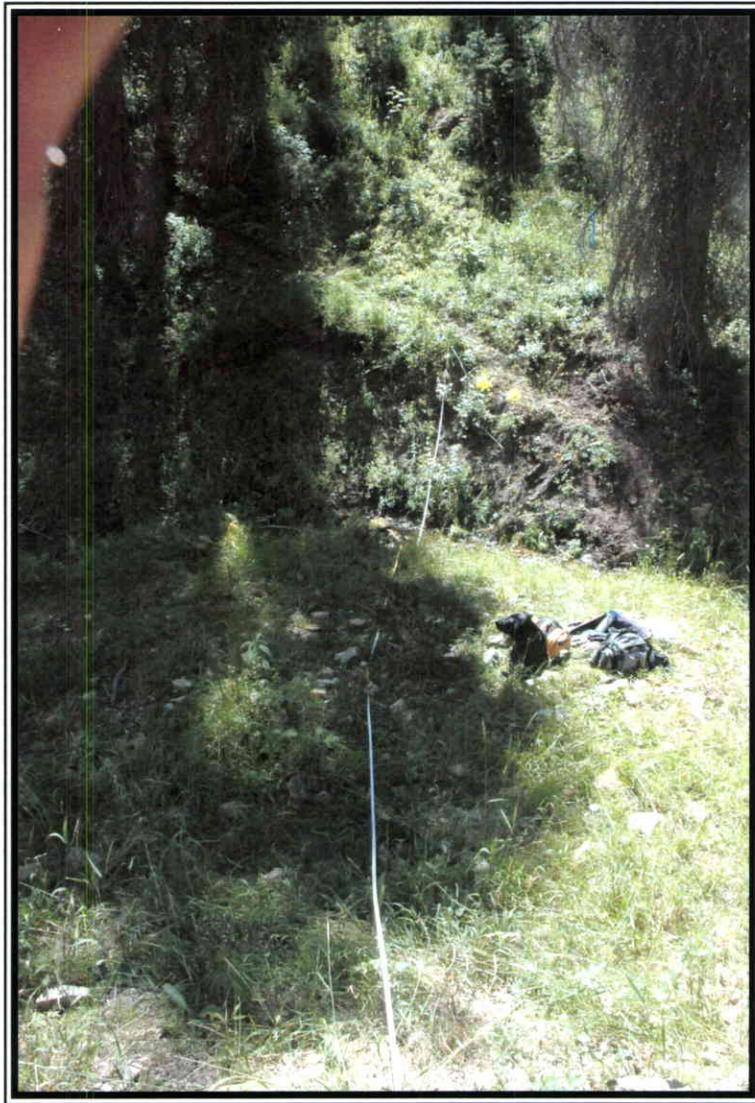
NOTES:

- 1) All of left bar was considered riparian-influenced (22.5 ft).
- 2) The right side has no riparian community and 100% cover.
- 3) New GPS coordinates were taken here.

DATA SUMMARY

WQ-01: Cover by community types in Winter Quarters Canyon (2010).	
UPLAND VEGETATION	Cover (ft)
	10.00
	10.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera/Elymus canadensis</i>	22.50
TOTAL COVER (Upland Species)	20.00
TOTAL COVER (Riparian Species)	22.50
ROCK (channel)	0.00
WATER (channel)	4.50
BAREGROUND (channel)	0.00
LITTER	0.00
MOSS	0.00
TOTAL COVER	47.00

PHOTOGRAPHIC DOCUMENTATION



WQ-01

**RIPARIAN COMPLEX DATA SHEET
2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-37 (New in 2010)

WATERBODY NAME: Winter Quarters Canyon Creek

LOCATION: Wasatch Plateau, Utah

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: E

STREAM GRADIENT: 1-2 °

ELEVATION: 8,622 ft

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen/Snowberry

Right: Conifer

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Stable

ESTIMATED FORAGE PRODUCTION: 850 lbs/acre

BEAVER ACTIVITY:

PHOTOGRAPH TAKEN:

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>		<i>Helianthella uniflora</i>	<i>Agrostis stolonifera</i>
<i>Populus angustifolia</i>		<i>Mimulus guttatus</i>	<i>Elymus canadensis</i>
		<i>Ranunculus cymbalaria</i>	
		<i>Urtica dioica</i>	

POOL ATTRIBUTES

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

AQUATIC VEGETATION

- % streambed with filamentous algae: no
- % stream margin with rooted aquatic: no

BANK TYPE & VEGETATION OVERHANG

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

BANK CONDITION

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

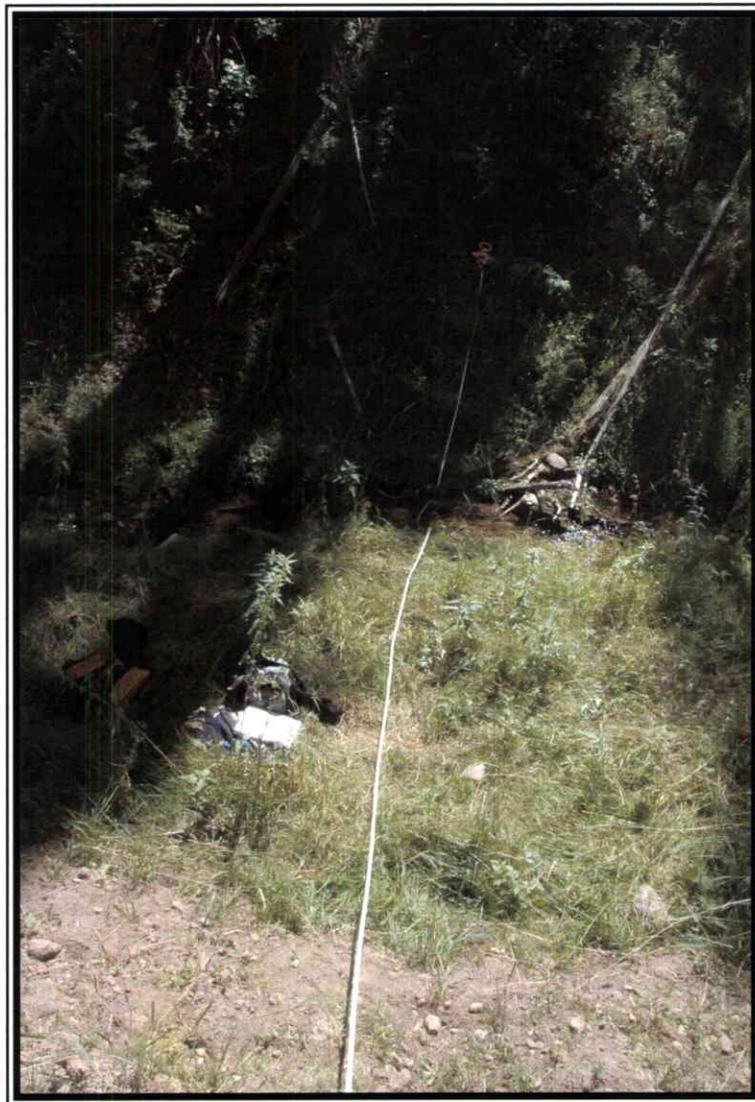
NOTES:

- 1) A new site in 2010.
- 2) The left side was a point bar with a good, flat riparian zone.
- 3) The right side was considered a riparian zone only to the steep bank (~ 2 ft). After that the vegetation was influence by side slope moisture.

DATA SUMMARY

WQ-37: Cover by community types in Winter Quarters Canyon (2010).	
UPLAND VEGETATION	Cover (ft)
	10.00
	10.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera/Elymus canadensis</i>	14.50
<i>Agrostis stolonifera/Ranunculus cymbalaria</i>	2.00
TOTAL COVER (Upland Species)	20.00
TOTAL COVER (Riparian Species)	16.50
ROCK (channel)	0.00
WATER (channel)	5.50
BAREGROUND (channel)	0.00
LITTER	0.00
MOSS	0.00
TOTAL COVER	42.00

PHOTOGRAPHIC DOCUMENTATION



WQ-37

**RIPARIAN COMPLEX DATA SHEET
2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-02

WATERBODY NAME: Winter Quarters Canyon Creek

LOCATION: Southern Wasatch Plateau, Utah; Bob's Canyon

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: E

STREAM GRADIENT: ~2°

ELEVATION: 8,619 ft

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Snowberry

Right: Spruce/Fir

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Increasing

ESTIMATED FORAGE PRODUCTION: 500 lbs./acre

BEAVER ACTIVITY: no

PHOTOGRAPH TAKEN: Yes

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Rosa woodsii</i>	<i>Carduus nutans</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Equisetum arvense</i>	<i>Bromus japonicus</i>
		<i>Geranium richardsonii</i>	<i>Carex hoodii</i>
		<i>Helianthella uniflora</i>	<i>Elymus canadensis</i>
		<i>Lupinus argenteus</i>	
		<i>Rubus idaeus</i>	
		<i>Rudbeckia occidentalis</i>	
		<i>Urtica dioica</i>	

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): 50
- % bank length gently sloping (>135°): 20
- % bank length with overhanging vegetation: 10

BANK CONDITION

- % bank length vegetated, stable: 65
- % bank length unvegetated, stable: 15
- % bank length vegetated, unstable: 10
- % bank length unvegetated, unstable: 10

NOTES:

- 1) The right side had a bench that supported some riparian species, but it was probably due to hillside moisture, not the stream directly.
- 2) The riparian area measured was well defined below the right bench and left hillside.
- 3) In 2009, we found the right stake, but not the left. We re-staked it at the previous measured length of (28 ft).
- 4) On the left side there was not much living cover; it was not stable on that side either.

DATA SUMMARY

**WQ-02: Cover by community types in Winter Quarters Canyon
 (2010).**

USDA Forest Service Protocol (1992)

UPLAND VEGETATION

10.50
 9.00

RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

Agrostis stolonifera/Equisetum arvense

1.00

Agrostis stolonifera/Carex hoodii

3.00

TOTAL COVER (Upland Species)

19.50

TOTAL COVER (Riparian Species)

4.00

ROCK (channel)

0.00

WATER (channel)

4.50

BAREGROUND (channel)

0.00

LITTER

0.00

MOSS

0.00

TOTAL COVER

28.00

PHOTOGRAPHIC DOCUMENTATION



WQ-02

**RIPARIAN COMPLEX DATA SHEET
2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-38 (New in 2010)

WATERBODY NAME: Winter Quarters Canyon Creek

LOCATION: Wasatch Plateau, Utah

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: N

STREAM GRADIENT: 1-2 °

ELEVATION: 8,566 ft

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen/Snowberry

Right: Conifer

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Stable

ESTIMATED FORAGE PRODUCTION: 500

BEAVER ACTIVITY: No

PHOTOGRAPH TAKEN: Yes

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Abies concolor</i>	<i>Ribes sp.</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
<i>Picea pungens</i>	<i>Rubus idaeus</i>	<i>Geranium richardsonii</i>	<i>Elymus canadensis</i>
<i>Populus tremuloides</i>	<i>Symphoricarpos oreophilus</i>	<i>Helianthella uniflora</i>	<i>Poa secunda</i>
		<i>Polygonum sp.</i>	
		<i>Ranunculus cymbalaria</i>	

POOL ATTRIBUTES

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

AQUATIC VEGETATION

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

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): 50 left
- % bank length gently sloping (>135°): 100 right
- % bank length with overhanging vegetation: 20 (herbaceous)

BANK CONDITION

- % bank length vegetated, stable: 90
- % bank length unvegetated, stable: 5
- % bank length vegetated, unstable: 0
- % bank length unvegetated, unstable: 5

NOTES:

- 1) New site for 2010

DATA SUMMARY

**WQ-38: Cover by community types in Winter Quarters Canyon
 (2010).**

USDA Forest Service Protocol (1992)

UPLAND VEGETATION

10.00
 9.00

RIPARIAN VEGETATION

Dominant Woody Species

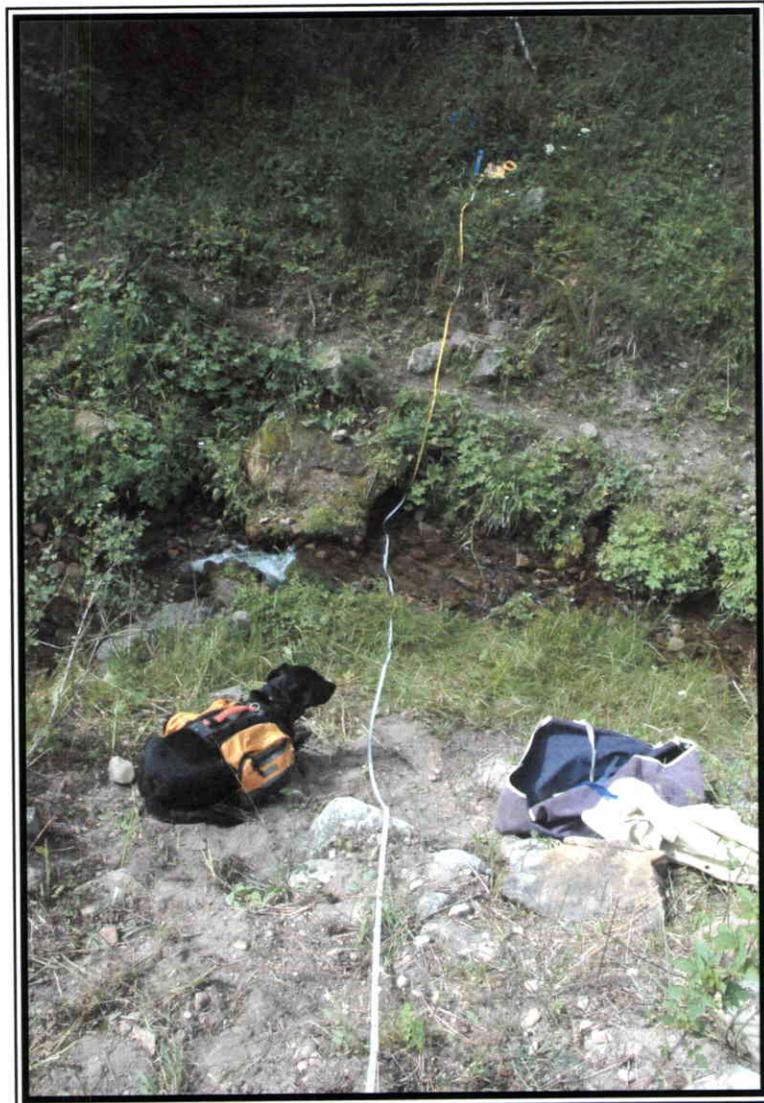
Dominant Herbaceous Species

<i>Geranium richardsonii/Elymus canadensis</i>	2.00
<i>Agrostis stolonifera/Ranunculus cymbalaria</i>	5.00

TOTAL COVER (Upland Species)	19.00
TOTAL COVER (Riparian Species)	7.00
ROCK (channel)	1.00
WATER (channel)	4.00
BAREGROUND (channel)	0.00
LITTER	0.00
MOSS	0.00

<u>TOTAL COVER</u>	<u>31.00</u>
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PHOTOGRAPHIC DOCUMENTATION



WQ-38

**RIPARIAN COMPLEX DATA SHEET
2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-05

WATERBODY NAME: Winter Quarters Canyon Creek

LOCATION: Wasatch Plateau, Utah

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: E

STREAM GRADIENT: 1-2 °

ELEVATION: 8,545ft

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen/Snowberry

Right: Conifer

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Decreasing; unstable right bank

ESTIMATED FORAGE PRODUCTION: 300

BEAVER ACTIVITY: no

PHOTOGRAPH TAKEN:

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Abies lasiocarpa</i>	<i>Ribes sp.</i>	<i>Geranium richardsonii</i>	<i>Agrostis stolonifera</i>
<i>Picea pungens</i>	<i>Salix sp.</i>	<i>Heracleum lanatum</i>	<i>Elymus canadensis</i>
<i>Populus tremuloides</i>	<i>Symphoricarpos oreophilus</i>	<i>Mimulus guttatus</i>	<i>Poa pratensis</i>
		<i>Ranunculus cymbalaria</i>	

POOL ATTRIBUTES

- % area in pools: 30
- % pool area made up of pools > 2' deep: no

AQUATIC VEGETATION

- % streambed with filamentous algae: no
- % stream margin with rooted aquatic: no

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): not on the transect line, but close upstream
- % bank length gently sloping (>135°): 25
- % bank length with overhanging vegetation:

BANK CONDITION

- % bank length vegetated, stable: 35
- % bank length unvegetated, stable: 15
- % bank length vegetated, unstable: 35
- % bank length unvegetated, unstable: 15

NOTES:

- 1) Reset GPS; previous coordinates put this site in an unlikely place.
- 2) This site was relocated ~ 50 ft downstream from old waypoint.
- 3) Previous stakes from years earlier were not found.
- 4) The right riparian bank was unstable.
- 5) This area was vulnerable to undercutting by high water.
- 6) This area is a less-than-desirable riparian monitoring station.
- 7) The site is now located just upstream from No-Name confluence.

DATA SUMMARY

**WQ-05: Cover by community types in Winter Quarters Canyon
 (2010).**

USDA Forest Service Protocol (1992)

UPLAND VEGETATION

10.00
 14.00

RIPARIAN VEGETATION

Dominant Woody Species

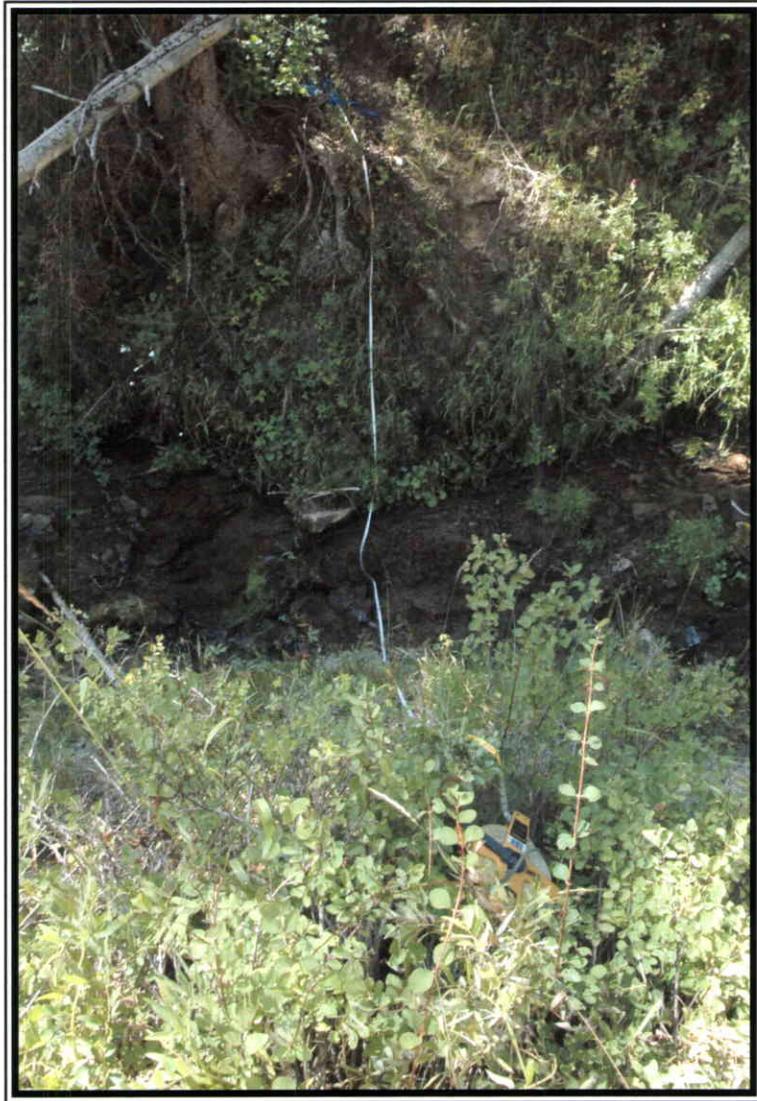
Dominant Herbaceous Species

Agrostis stolonifera 1.00
Agrostis stolonifera/Ranunculus cymbalaria 1.00

TOTAL COVER (Upland Species) 24.00
TOTAL COVER (Riparian Species) 2.00
ROCK (channel) 1.50
WATER (channel) 4.50
BAREGROUND (channel) 0.00
LITTER 0.00
MOSS 0.00

TOTAL COVER 32.00

PHOTOGRAPHIC DOCUMENTATION



WQ-05

**RIPARIAN COMPLEX DATA SHEET
2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-39 (New in 2010)

WATERBODY NAME: Winter Quarters Canyon Creek

LOCATION: Wasatch Plateau, Utah

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: E

STREAM GRADIENT: 1-2 °

ELEVATION: 8,507ft

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen/Snowberry

Right: Conifer

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Stable

ESTIMATED FORAGE PRODUCTION: 800

BEAVER ACTIVITY: no

PHOTOGRAPH TAKEN: *Yes*

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Ribes sp.</i>	<i>Aster sp.</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Rubus idaeus</i>	<i>Geranium richardsonii</i>	<i>Elymus canadensis</i>
		<i>Helianthella uniflora</i>	<i>Carex hoodii</i>
		<i>Heracleum lanatum</i>	
		<i>Lathyrus pauciflorus</i>	
		<i>Mimulus guttatus</i>	
		<i>Ranunculus cymbalaria</i>	
		<i>Urtica dioica</i>	

POOL ATTRIBUTES

- % area in pools: 0
- % pool area made up of pools > 2' deep: no

AQUATIC VEGETATION

- % streambed with filamentous algae: no
- % stream margin with rooted aquatic: no

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): 100 on right side
- % bank length gently sloping (>135°): 100 on left side
- % bank length with overhanging vegetation: 50 (woody)

BANK CONDITION

- % bank length vegetated, stable: 90
- % bank length unvegetated, stable: 5
- % bank length vegetated, unstable: 5
- % bank length unvegetated, unstable: 0

NOTES:

- 1) New site in 2010
- 2) I considered all but 10 ft out from fallen tree as a riparian community.
- 3) The site was mostly *Elymus canadensis* which appeared a bit more mesic than wet.
- 4) The site was located just below a spring on the right.

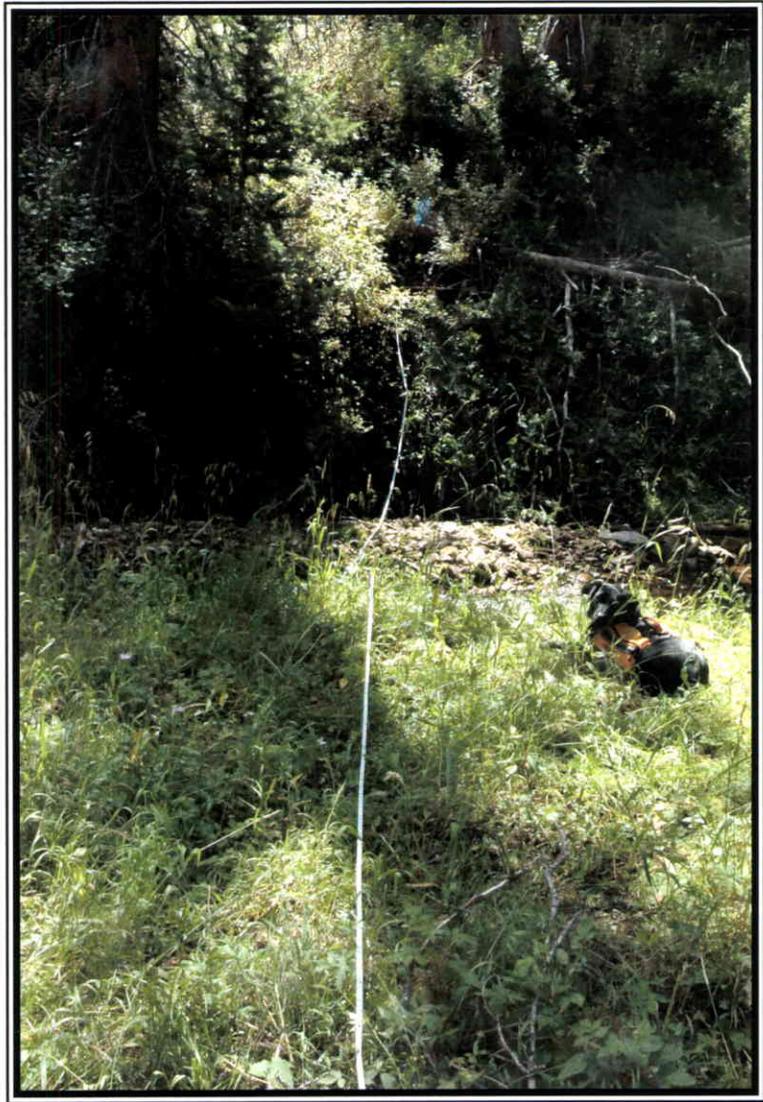
DATA SUMMARY

**WQ-39: Cover by community types in Winter Quarters Canyon
 (2010).**

USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
	10.00
	9.00
 RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
 <u>Dominant Herbaceous Species</u>	
<i>Elymus canadensis/Carex hoodii</i>	15.00
<i>Geranium richardsonii/Elymus canadensis</i>	1.00
TOTAL COVER (Upland Species)	19.00
TOTAL COVER (Riparian Species)	16.00
ROCK (channel)	4.50
WATER (channel)	4.50
BAREGROUND (channel)	0.00
LITTER	1.00
MOSS	0.00
<hr/> TOTAL COVER <hr/>	<hr/> 45.00 <hr/>

PHOTOGRAPHIC DOCUMENTATION



WQ-30

**RIPARIAN COMPLEX DATA SHEET
2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-07

WATERBODY NAME: Winter Quarters Canyon Creek

LOCATION: Wasatch Plateau, Utah

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: E

STREAM GRADIENT: 1-2 °

ELEVATION: 8,513

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen/Conifer

Right: Conifer

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Stable

ESTIMATED FORAGE PRODUCTION: 900 lbs/acre

BEAVER ACTIVITY: no

PHOTOGRAPH TAKEN: Yes

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Ribes sp.</i>	<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Aster sp.</i>	<i>Carex hoodii</i>
		<i>Carduus nutans</i>	
		<i>Geranium richardsonii</i>	
		<i>Helianthella uniflora</i>	
		<i>Polygonum sp.</i>	
		<i>Ranunculus cymbalaria</i>	

POOL ATTRIBUTES

- % area in pools: 50
- % pool area made up of pools > 2' deep: no

AQUATIC VEGETATION

- % streambed with filamentous algae: no
- % stream margin with rooted aquatic: no

BANK TYPE & VEGETATION OVERHANG

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

BANK CONDITION

	Left	Right
% bank length vegetated, stable:	100	75
% bank length unvegetated, stable:	0	0
% bank length vegetated, unstable:	0	15
% bank length unvegetated, unstable:	0	10

NOTES:

- 1) I could not find the old site; GPS coordinates went to an area with lots of fallen trees, so it may have been covered up.
- 2) A new station was created, so previous data (pre-2010) cannot be compared to 2010 and later.
- 3) The left side riparian area was mostly level.
- 4) The right side had bank-influence moisture with only 2 ft influenced mostly from the stream.
- 5) This may be one of Dr. Shiozawa's macroinvertebrate sample sites?

DATA SUMMARY

**WQ-07: Cover by community types in Winter Quarters Canyon
 (2010).**

USDA Forest Service Protocol (1992)

UPLAND VEGETATION

10.00
 10.00

RIPARIAN VEGETATION

Dominant Woody Species

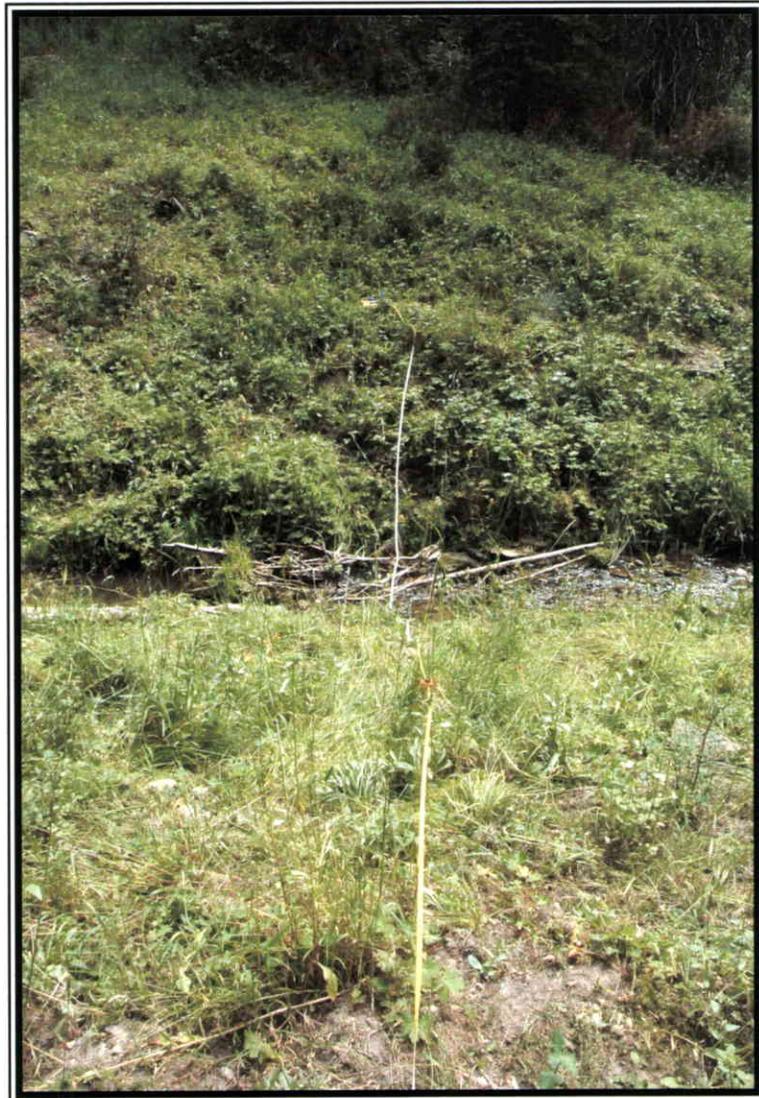
Dominant Herbaceous Species

<i>Agrostis stolonifera/Ranunculus cymbalaria</i>	2.00
<i>Elymus canadensis/Carex hoodii</i>	9.00

TOTAL COVER (Upland Species)	20.00
TOTAL COVER (Riparian Species)	11.00
ROCK (channel)	1.00
WATER (channel)	6.00
BAREGROUND (channel)	0.00
LITTER	0.00
MOSS	0.00

TOTAL COVER	38.00
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PHOTOGRAPHIC DOCUMENTATION



WQ-07

**RIPARIAN COMPLEX DATA SHEET
2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-40 (New in 2010)

WATERBODY NAME: Winter Quarters Canyon Creek

LOCATION: Wasatch Plateau, Utah

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: E

STREAM GRADIENT: 1-2 °

ELEVATION: 8,492 ft

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Blue Spruce/Conifer

Right: Conifer

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Stable

ESTIMATED FORAGE PRODUCTION: 1,000 lbs/acre

BEAVER ACTIVITY: No

PHOTOGRAPH TAKEN: *Yes*

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Ribes sp.</i>	<i>Achillea millefolium</i>	<i>Agrostis stolonifera</i>
		<i>Mimulus guttatus</i>	
		<i>Potentilla sp.</i>	
		<i>Ranunculus cymbalaria</i>	
		<i>Urtica dioica</i>	
		<i>Viguiera multiflora</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:

BANK CONDITION

% bank length vegetated, stable: 100

% bank length unvegetated, stable: 0

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

NOTES:

- 1) A good, well-defined riparian community was present on the left side.
- 2) The right side had little riparian community.
- 3) This was a new site in 2010.
- 4) Site was located just upstream from the No Name trail head I marked.

DATA SUMMARY

**WQ-40: Cover by community types in Winter Quarters Canyon
(2010).**

USDA Forest Service Protocol (1992)

UPLAND VEGETATION

10.00
10.00

RIPARIAN VEGETATION

Dominant Woody Species

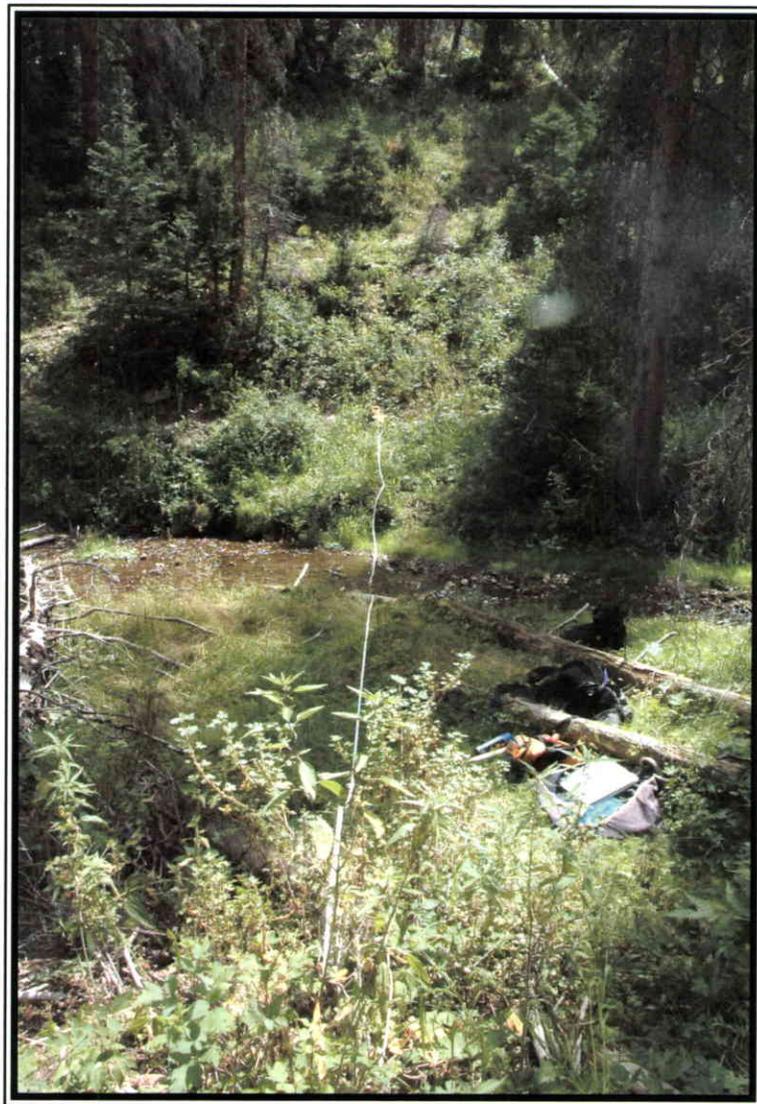
Dominant Herbaceous Species

<i>Agrostis stolonifera/Ranunculus cymbalaria</i>	14.50
<i>Agrostis stolonifera</i>	2.00

TOTAL COVER (Upland Species)	20.00
TOTAL COVER (Riparian Species)	16.50
ROCK (channel)	1.00
WATER (channel)	8.00
BAREGROUND (channel)	0.00
LITTER	0.50
MOSS	0.00

TOTAL COVER	46.00
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PHOTOGRAPHIC DOCUMENTATION



WQ-40

**RIPARIAN COMPLEX DATA SHEET
2010**

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Number WQ-09

WATERBODY NAME: Winter Quarters Canyon Creek

LOCATION: Wasatch Plateau, Utah

DATE: August 25 - 31, 2010

OBSERVER(S): P.D. Collins

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: ENE

STREAM GRADIENT: 1-2 °

ELEVATION: 8,448ft

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Conifer

Right: Conifer

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Stable

ESTIMATED FORAGE PRODUCTION:

BEAVER ACTIVITY: No

PHOTOGRAPH TAKEN: *Yes*

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

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
	<i>Symphoricarpos oreophilus</i>	<i>Helianthella uniflora</i>	<i>Carex hoodii</i>
		<i>Mimulus guttatus</i>	<i>Elymus canadensis</i>
		<i>Geranium richardsonii</i>	<i>Poa secunda</i>
		<i>Ranunculus cymbalaria</i>	
		<i>Urtica dioica</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°): 20% on right side
- % bank length gently sloping (>135°): 100% on left side
- % bank length with overhanging vegetation: 20 (herbaceous)

BANK CONDITION

- % bank length vegetated, stable: 65
- % bank length unvegetated, stable: 20
- % bank length vegetated, unstable: 10
- % bank length unvegetated, unstable: 5

NOTES:

- 1) Even though it was an old site, all stakes were located.
- 2) The coordinates were remarked on the GPS

DATA SUMMARY

**WQ-09: Cover by community types in Winter Quarters Canyon
 (2010).**

USDA Forest Service Protocol (1992)

UPLAND VEGETATION

9.00
 11.00

RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

Agrostis stolonifera

2.00

Agrostis stolonifera/Carex hoodii

3.00

TOTAL COVER (Upland Species)

20.00

TOTAL COVER (Riparian Species)

5.00

ROCK (channel)

6.00

WATER (channel)

2.00

BAREGROUND (channel)

0.00

LITTER

0.00

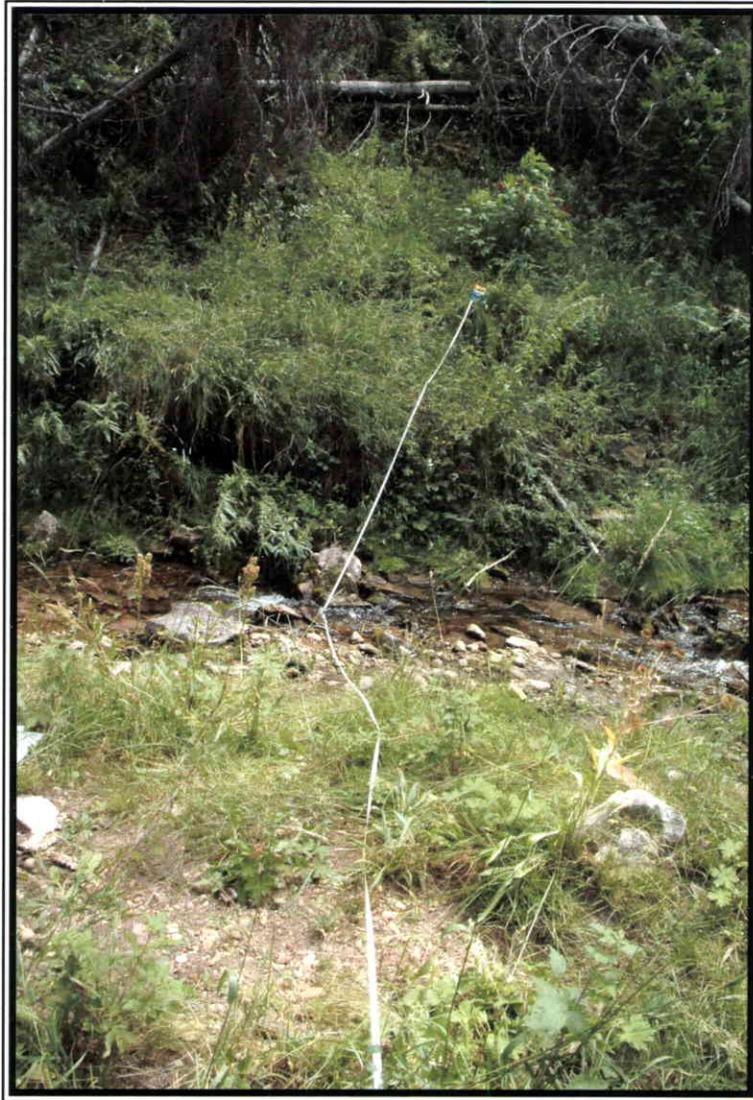
MOSS

0.00

TOTAL COVER

33.00

PHOTOGRAPHIC DOCUMENTATION



WQ-09



February 11, 2011

Mr. Gregg Galecki
Canyon Fuel Company
Skyline Canyon Mine
HC 35 Box 380
Helper, Utah 84526

Dear Mr. Galecki:

Enclosed are the results for soil samples our laboratory received on November 19, 2010. The analyses were completed according to methods described in USDA Handbook 60 and the American Society of Agronomy monographs.

Feel free to contact me at your convenience if you have any questions or concerns.

Sincerely,

Karen Secor
Mining Soils

xc: File
Encl.



Soil Analysis Report

Canyon Fuel Company, LLC.

HCR 35, Box 380
Helper, UT 84526

Report ID: S1012061001

Project: Skyline Utah#6

Date Received: 11/19/2010

Date Reported: 2/4/2011

Work Order: S1012061

Lab ID	Sample ID	pH s.u.	Saturation %	Electrical Conductivity dS/m	Field Capacity %	Wilf Point %	PE		PE		SAR
							Calcium meq/L	Magnesium meq/L	Potassium meq/L	Sodium meq/L	
S1012061-001	WR2010-1	7.5	44.7	2.15	30.4	9.8	17.5	9.63	1.06	3.97	1.08
S1012061-002	WR2010-2	7.8	45.0	1.13	30.5	9.2	5.51	4.30	0.75	1.83	0.83

These results apply only to the samples tested.

Abbreviations for extracts: PE= Saturated Paste Extract, H2OSol= water soluble, AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, Pyr+S= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

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



Inter-Mountain Labs

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

Your Environmental Monitoring Partner

Soil Analysis Report

Canyon Fuel Company, LLC.

HCR 35, Box 380
Helper, UT 84526

Report ID: S1012061001

Date Reported: 2/4/2011

Work Order: S1012061

Project: Skyline Utah#6

Date Received: 11/19/2010

Lab ID	Sample ID	Sand			Silt		Clay		Texture	Coarse Fragment		Available Selenium		Available Boron		Nitrate (as N)		TKN
		%	%	%	%	%	%	ppm		ppm	ppm	ppm	ppm	ppm	%			
S1012061-001	WR2010-1	77.0	17.0	6.0				Loamy Sand	<0.01	<0.02	1.57	<0.1	0.61					
S1012061-002	WR2010-2	84.0	12.0	4.0				Loamy Sand	<0.01	<0.02	0.79	<0.1	0.58					

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2Osol= water soluble, AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

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

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

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



Soil Analysis Report
Canyon Fuel Company, LLC.

HCR 35, Box 380
Helper, UT 84526

Report ID: S1012061001

Project: Skyline Utah#6

Date Reported: 2/4/2011

Date Received: 11/19/2010

Work Order: S1012061

Lab ID	Sample ID	Available Sodium		Exchangeable Sodium		Total Carbon		Total Sulfur		T.S.		Neutral Potential		T.S.	
		meq/100g	meq/100g	meq/100g	meq/100g	%	%	%	%	AB	AB	1/1000t	1/1000t	ABP	1/1000t
S1012061-001	WR2010-1	0.33	0.15	0.15	0.15	50.4	50.4	50.0	0.45	13.9	13.9	32.2	32.2	18.3	18.3
S1012061-002	WR2010-2	0.16	0.08	0.08	0.08	63.9	63.9	63.4	0.45	14.1	14.1	42.2	42.2	28.0	28.0

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2OSol= water soluble, AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

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

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

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



March 3, 2011

Mr. Gregg Galecki
Canyon Fuel Company
Skyline Canyon Mine
HC 35 Box 380
Helper, Utah 84526

Dear Mr. Galecki:

Enclosed are the results for soil samples our laboratory received on January 21, 2011. The analyses were completed according to methods described in USDA Handbook 60 and the American Society of Agronomy monographs.

Feel free to contact me at your convenience if you have any questions or concerns.

Sincerely,

A handwritten signature in cursive script, appearing to read 'Karen Secor', written over a circular stamp.

Karen Secor
Mining Soils

xc: File
Encl.



Soil Analysis Report
Canyon Fuel Company, LLC.

Report ID: S1101222001

HCR 35, Box 380
Helper, UT 84526

Project: Skyline Utah#6

Date Reported: 2/22/2011

Date Received: 1/21/2011

Work Order: S1101222

Lab ID	Sample ID	pH	Saturation %	Electrical		Field Capacity %	Wilting Point %	PE			SAR
				Conductivity dS/m	Conductivity %			Calcium meq/L	Magnesium meq/L	Potassium meq/L	
S1101222-001	WR2010-3	8.0	45.1	0.32	20.1	8.1	1.75	0.45	0.10	0.53	0.51
S1101222-002	WR2010-4	8.0	36.7	0.26	19.2	6.7	1.48	0.38	0.08	0.32	0.33

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2OSol= water soluble, AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

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

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

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



Soil Analysis Report

Canyon Fuel Company, LLC.

HCR 35, Box 380
Helper, UT 84526

Report ID: S1101222001

Project: Skyline Utah#6

Date Received: 1/21/2011

Date Reported: 2/22/2011

Work Order: S1101222

Lab ID	Sample ID	Sand		Silt	Clay	Texture	Coarse Fragment		Available Selenium		Available Boron		Nitrate (as N)		TKN
		%	%	%	%		%	%	ppm	ppm	ppm	ppm	%		

S1101222-001	WR2010-3	52.0	32.0	16.0	9.08	Sandy Loam	<0.02	0.28	0.1	0.05
S1101222-002	WR2010-4	64.0	23.0	13.0	6.29	Sandy Loam	<0.02	0.16	<0.1	0.14

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2OSol= water soluble, AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

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

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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor



Soil Analysis Report

Canyon Fuel Company, LLC.

HCR 35, Box 380
Helper, UT 84526

Report ID: S1101222001

Project: Skyline Utah#6

Date Reported: 2/22/2011

Date Received: 1/21/2011

Work Order: S1101222

Lab ID	Sample ID	Available Sodium		Exchangeable Sodium		Total Carbon		Total Sulfur		T.S.		Neutral. Potential		T.S.	
		meq/100g	meq/100g	meq/100g	meq/100g	%	%	%	%	AB	AB	ABP	ABP	1/1000t	1/1000t
S1101222-001	WR2010-3	0.08	0.06	0.06	0.06	2.3	1.7	0.02	0.02	0.63	0.63	46.8	46.8	46.2	46.2
S1101222-002	WR2010-4	0.03	0.02	0.02	0.02	1.4	0.7	0.02	0.02	0.47	0.47	56.2	56.2	55.7	55.7

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2OSol= water soluble, AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

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

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

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



Canyon Fuel
Company, LLC.
Skyline Mine

A Subsidiary of Arch Western Bituminous Group, LLC.

Gregg Galecki, Environmental Eng.
HCR 35, Box 380
Helper, UT 84526
(435) 448-2636 - Office
(435) 448-2632 - Fax

January 17, 2011

Ms. Karen Secor
Inter-Mountain Laboratories, Inc.
1633 Terra Avenue
Sheridan, Wyoming 82801

RE: Two (2) Samples for Analysis According to the Parameters Listed in Table 6 of the Utah Division of Oil, Gas and Mining Guidelines for Topsoil and Overburden

Dear Ms. Secor:

Please find enclosed in this box two (2) samples (WR2010-3, and WR2010-4) for analysis in accordance with the parameters listed in Table 6 of the Utah Division of Oil, Gas and Mining Guidelines for Topsoil and Overburden.

Prior to invoicing, please call me and I will provide you a purchase order number.

If you have any questions regarding these samples, please give me a call at (435) 448-2636.

Sincerely,

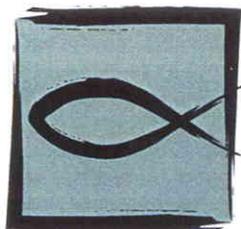
Gregg A. Galecki
Environmental Engineer – Skyline Mines
Canyon Fuel Company, LLC.
(435) 448-2636
ggalecki@archcoal.com

Rec'd 1/21/11
Karen Secor

51101222

ESTIMATES OF THE FALL, 2010,
CUTTHROAT TROUT POPULATION DENSITIES
IN ECCLES CREEK,
TRIBUTARY TO SCOFIELD RESERVOIR

CARBON COUNTY, UTAH



Prepared by

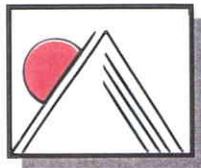
MT. NEBO SCIENTIFIC, INC.
330 East 400 South, Suite 6
Springville, Utah 84663
(801) 489-6937

by

Dennis K. Shiozawa, Ph.D.

for

CANYON FUEL COMPANY, LLC.
Skyline Mines
HC 35 Box 380
Helper, Utah 84526



December 2010

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INTRODUCTION

In the late summer and fall of 2001, water entering Skyline Mine of Canyon Fuel Company was allowed to discharge water from an underground aquifer into Eccles Creek to prevent mine flooding. At that time, several studies were initiated to assess the impact of the increased flows on the biota of Eccles Creek. Most of the assessment has focused on the invertebrate communities of the stream, but electrofishing surveys were included to evaluate the response of fish to the discharge. In 2001 an initial qualitative survey found no fish. However by 2004, fish had been seen in the stream, and fish survey stations were established at each of the three benthos sampling stations in Eccles Creek. This report compares the fish densities and species composition in the three reaches in September, 2010, with those recorded in October, 2004 and October, 2007.

METHODS

On October 5, 2004, sample stations were established at each of three sections of Eccles Creek (Table 1). A fourth station was established in the South Fork of Eccles Creek. The sites were initially marked with flagging to allow easy location when the population estimates were conducted. The first series of population estimates were conducted in October, 2004. In 2007, samples were completed in late September and early October (Table 1). In September, 2010 the station coordinates were relocated and stream-lengths re-measured.

Table 1. Sampling Stations on Eccles Creek

Station	Date	GPS Coordinates Start Location	GPS Coordinates End Location
Lower Eccles Creek	September 26, 2010	N 39° 41' 0.87" W 111° 9' 57.47"	N 39° 41' 0.06" W 111° 10' 1.86"
Middle Eccles Creek (above Whisky Canyon)	September 18, 2010	N 39° 40' 55.54" W 111° 10' 40.11"	N 39° 40' 54.48" W 111° 10' 44.82"
Upper Eccles Creek	September 18, 2010	N 39° 40' 58.20" W 111° 11' 34.74"	N 39° 40' 55.79" W 111° 11' 27.39"
South Fork Eccles Creek	September 28, 2010	N 39° 40' 55.79" W 111° 11' 27.39"	N 39° 40' 53.06" W 111° 11' 30.90"

Fish population estimates were based on removal summation sampling (Moran 1951; Zippen 1956, 1958; Van Deventer and Platts 1985) within the marked sections of stream. The fish were captured with a Smith-Root Model 12 battery-powered backpack electrofisher. All captured fish were transferred to buckets and were held in flow-through holding pens. The fish captured on the second run were held in buckets until the electrofishing crew reached an appropriate location below an instream barrier. The fish were released below the barrier to avoid recaptures. The holding pens were set up below small barriers so that the first run fish could be processed and released on the second run. When approaching a holding pen on the second run, electrofishing was suspended while the caged fish were moved downstream to avoid potential injuries to the captive fish from the electric field. Once the stream was electrofished to the barrier the fish in the holding pens were identified, measured, counted, and released. Electrofishing was then continued above the barrier. All field equipment, including boots, holding pens, buckets, nets, and the electrofisher, were sterilized with a quaternary ammonium-based compound prior to entering each stream section and again immediately after leaving each stream section. This was to prevent inadvertent transfer of invasive aquatic taxa either into or out of the streams.

RESULTS AND DISCUSSION

The re-measuring of stream lengths between the recorded coordinate locations found that the original sites were 150 meters in length, not the 100 meters used in the previous estimates. The corrected densities for 2004 and 2007 are given below (Table 3), but since the previous reports discussed the dynamics in relative total densities, no changes in the interpretation of the data are necessary other than recognizing the reduced density of fish per meter of stream channel. The stream is beginning to have increased instream moss growth, taking on more of a spring creek-like appearance.

The 2010 sampling resulted in relatively narrow confidence ranges for both the Middle and Upper Eccles Creek stations (Table 2) while the Lower Eccles Creek station had wider confidence intervals. This difference was due to changes in stream discharge. When the Middle and Upper stations were sampled the pumps emptying water into the stream channel from the mine had been shut off for maintenance, thus the water was considerably lower and few fish escaped on the first run in both stations. This is reflected in the capture probability where over 77% of the fish were captured in the first runs (Table 2). When the Lower Eccles Creek station was sampled water was flowing at bank-full levels, and

even though we had a larger crew to help in the collecting, the capture probability was 63.6%.

The Lower Eccles Creek station had a total population estimate of 109 fish in 2007 (Table 3) but in 2010 it was estimated at 64 fish, 45% less than the 2007 estimate. Likewise Upper Eccles Creek showed a 52% decline in trout from 2007 to 2010 but the Middle Eccles Creek station did not change in density. As in the 2007 sampling, the South Fork of Eccles Creek did not contain any fish, but if it were to hold fish, it would only have young-of-the-year trout since it is too small and shallow to allow larger fish to survive. It does not appear to have good spawning habitat and most of the reach is blocked to fish access by a major silted-in debris barrier. In the three sampling periods, 2004, 2007, and 2010 only one fish was collected in the South Fork of Eccles Creek and it was a young-of-the-year individual found below the debris barrier.

Table 2. Population estimates and confidence intervals for Eccles Creek, October, 2010

Station	Capture probability	Population Estimate	Lower 95% Confidence Interval	Upper 95% Confidence Interval
Lower Eccles Creek	0.636	64	50.6	77.4
Middle Eccles Creek	0.775	32	31.0	36.2
Upper Eccles Creek	0.805	34	30.5	37.5
South Fork Eccles Creek	--	0	0	0

In 2007 a relatively high number of F1 hybrids and rainbow trout in the stream (Table 4). However in 2010 only one trout with an F1 phenotype was captured and no rainbow trout were found in the stream. The absence of rainbow trout may be associated with the termination of stocking of fertile rainbow trout by the State of Utah, and the remaining population may now be slightly introgressed with rainbow trout, but shows a predominantly cutthroat trout phenotypes. The single hybrid trout found in Lower Eccles Creek was about 25 cm in total length, making it either from the 2007 age 0+ cohort a fish that was spawned the following year. This fish was not kept separate in the analyses.

The length of the trout collected allowed separation of fish into size classes although accurate age estimation would require scale or otolith examination. It is likely that the larger fish collected in this survey were age 2+ or 3+ with some of the largest possibly being older. The high elevation of the site suggests that the largest fish are 3+ to 5+ years in age, but the increased stream temperature resulting from the mine discharge could confound the elevation effect by favoring more rapid annual growth, making the largest fish somewhat younger.

The length frequencies for 2004 covered a range from 5 cm to 29 cm and showed a dominance of small trout, age 0+ and 1+ (5-10 cm). The most robust size structure occurred in the Lower Eccles Creek population, and the weakest size structure was in the Upper Eccles Station where low frequencies of all size classes occurred. In 2007, the size frequencies shifted. Lower Eccles Creek (Figure 1) still showed the most diverse size range, but the Middle Eccles Creek (Figure 2) station had a significant drop in the proportion of small trout in the population. Approximately half of the fish were less than 15 cm in length, and the other half were over 20 cm in length. In 2007 the Upper Eccles Station (Figure 3) had a length frequency distribution that was similar to the 2004 Middle Eccles station. The overall size structure of the combined three 2007 stations (Figure 4) suggested that the stream trout population was robust and in better condition than in 2004.

Table 3. Comparison of population estimates and densities for Eccles Creek, October, 2004, October, 2007, and September 2010.

Station	Population Estimate			Density per Linear Meter of Stream		
	2004	2007	2010	2004	2007	2010
Year						
Lower Eccles Creek	90	109	64	0.600	0.727	0.427
Middle Eccles Creek	93	32	32	0.620	0.213	0.213
Upper Eccles Creek	15	71	34	0.100	0.473	0.227
South Fork Eccles Creek	1	0	0	0.007	0.000	0.000
Total Estimate (600 m of stream)	160	212	130	0.267	0.353	0.243

Table 4. Percent composition of phenotypes for Eccles Creek, September, 2010

Station	Cutthroat Trout or introgressed cutthroat trout		F1 Hybrids		Rainbow Trout	
	2007	2010	2007	2010	2007	2010
Lower Eccles Creek	85.3%	98.4%	10.8%	1.6%	3.9%	0
Middle Eccles Creek	97.1%	100%	2.9%	0	0	0
Upper Eccles Creek	95.8%	100%	0	0	4.2%	0
South Fork Eccles Creek	0	0	0	0	0	0

The 2010 Lower Eccles Creek population (Figure 5) has a length frequency that appears very similar to the 2007 Lower Eccles profile except that the young-of-the-year (age 0+) frequencies are about half those recorded in 2007. The 2010 population has more older fish. The decline in age 0+ fish suggests either less in-stream spawning or lower survival of fry in the stream. The strong 2007 0+ cohort will grow into the 2010 3+ age class in the stream. The 2010 Middle Eccles Creek Station (Figure 6) had low numbers of both age 0+ and older fish. When compared to the 2007 data (Figure 2) the samples appear to be quite similar. This station was well armored in 2007 and it was still armored in the 2010 census. In contrast both the upstream and downstream stations had more habitat heterogeneity, with more in-stream brush trees and areas blown out by the collapse of woody debris under the carbonate shelf.

The 2010 Upper Eccles Creek Station (Figure 7) contained more large fish than it did in 2007, but the age 0+ fish were approximately a tenth the density collected in 2007, reflecting what was seen in the lower station. The older age classes in the Upper Station in 2010 were about double their density in the 2007 survey so the bulk of the difference in the population estimates was due to the loss of the 0+ age class. The differences in fish densities between 2010 and 2007 can be easily appreciated by comparing the combined length frequency for 2010 (Figure 8) with that for 2007 (Figure 4). Of note is that the smaller age classes, 0+ and 1+ in 2010 are less than half those collected in 2007. The older age classes appear to be about the same. The combined length-frequency profile for 2007 approximates what would be expected in a self-recruiting stream population with more young-of-the-year fish than in the age 1+ age class. A gradual decline in numbers with age would be expected in a stable population. The 2010 combined densities (Figure 8) show fewer young-of-the-year (age 0+) fish than the later age classes. This is indicative of an unstable or fluctuating population.

The poor of recruitment in Eccles Creek in 2010 portends a population decline in the stream system in the near future. Since the number of age 0+ trout is roughly equal to the number of fish in the older age classes, recruitment into the higher age classes over the next few years will be lower than it has been in the past. As the age 0+ fish grow into the next several age classes, natural mortality will reduce their numbers further. In fact, assuming that the 2007 length frequency is a rough estimate of a time-specific survivorship curve, approximately half of the fish die in transition from one age class to the next. The only possible mitigation to a declining population will be migration of fish into Eccles Creek from downstream locations.

The factors involved in the decline are not obvious, but several factors could be involved. Some are related to the physical changes the stream is undergoing

and the others are related to biotic interactions in the system. The physical changes are directly related to the armoring of the stream bed. Armoring has been progressing downstream since benthic monitoring began in 2001. This armoring, which is dominated by calcium carbonate precipitation on the stream bed, has two effects. First, it cements sediment particles together, eliminating gravel beds which are required for successful spawning and, second, it significantly simplifies the stream bed complexity, reducing shelter for small trout. This increases their vulnerability to both predation and flushing during rapid fluctuations in in-stream flow. An additional biotic factor of concern is the age structure of trout in the stream. Given the length frequency profiles, it is possible that only the largest trout in the stream are responsible for the majority, if not all, of the egg production in the stream. If the trout are still successfully spawning in stream reaches above the mine outflow, the total number of eggs being laid can be limited by any reduction in the number of large fish in the stream (Belk et al 2009). Thus harvest of large fish may result in a reduction of recruitment on the order of hundreds of fry per female removed.

The overall impact of the above factors on the Eccles Creek cutthroat trout population will depend on the life history of the trout in the stream. If they are constrained to Eccles Creek for reproduction and recruitment, the population will decline. If the trout out-migrate for spawning and fish immigrate into the stream for foraging, then Eccles Creek may reach an equilibrium density that does not rely on production and survival of young-of-the-year trout within Eccles Creek. Instead their number will be based on the dynamics of the larger metapopulation in the Mud Creek drainage.

Figure 1. Length frequency of trout from the Lower Eccles Creek Station, 2007.

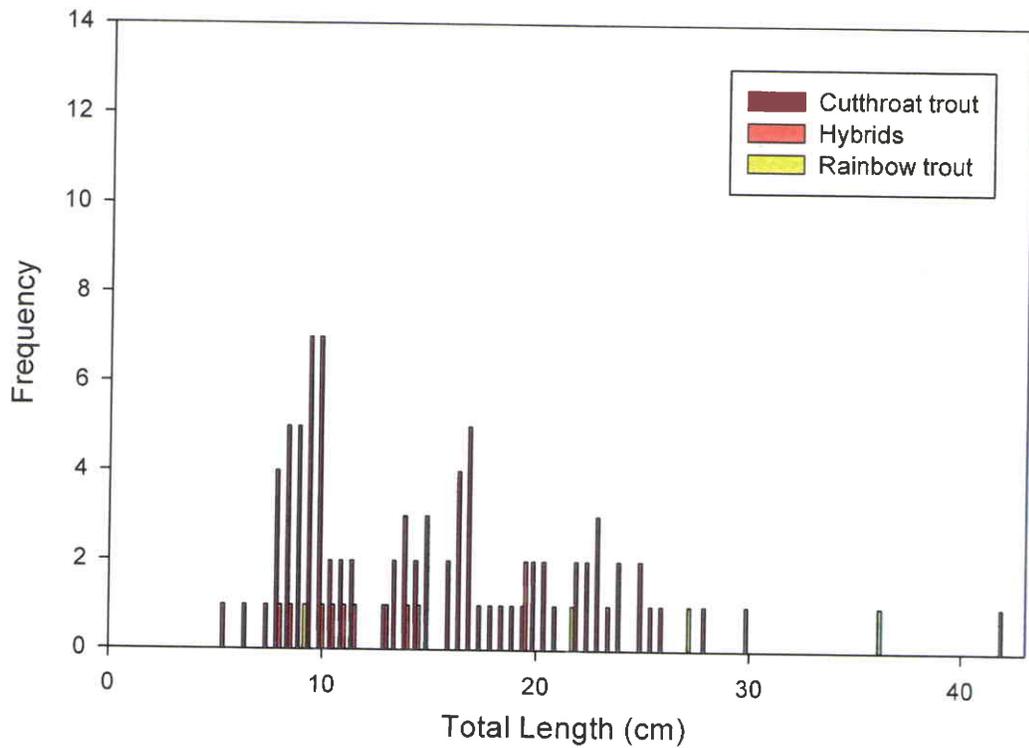


Figure 2. Length Frequency of trout from the Middle Eccles Creek Station, 2007.

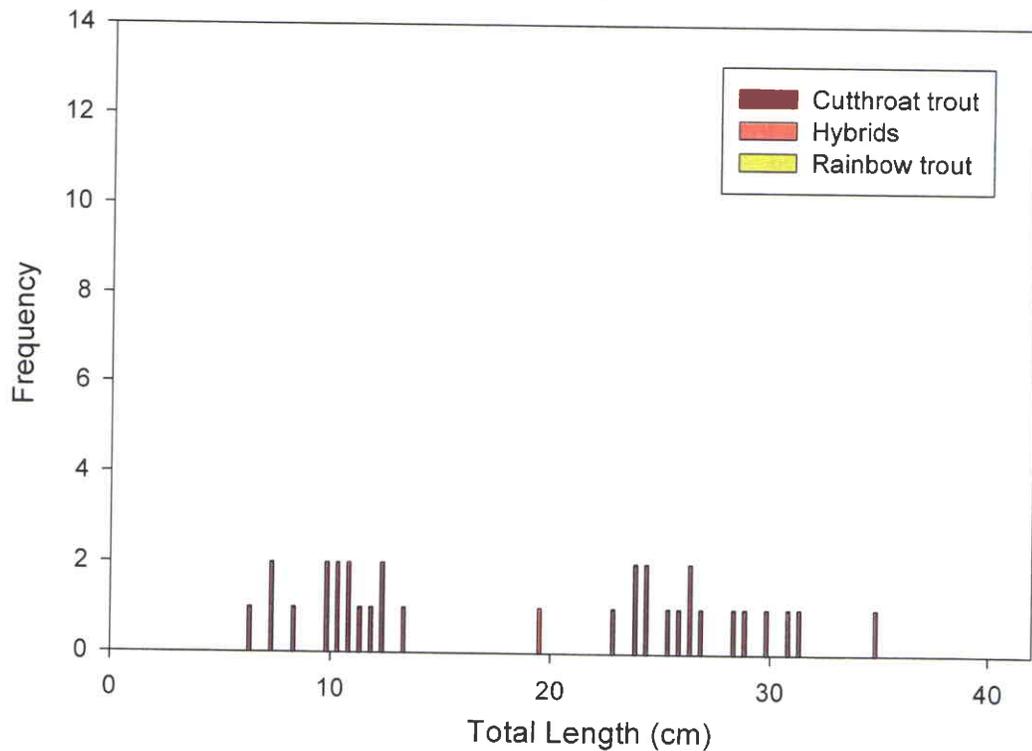


Figure 3. Length frequency of trout from the Upper Eccles Creek Station, 2007.

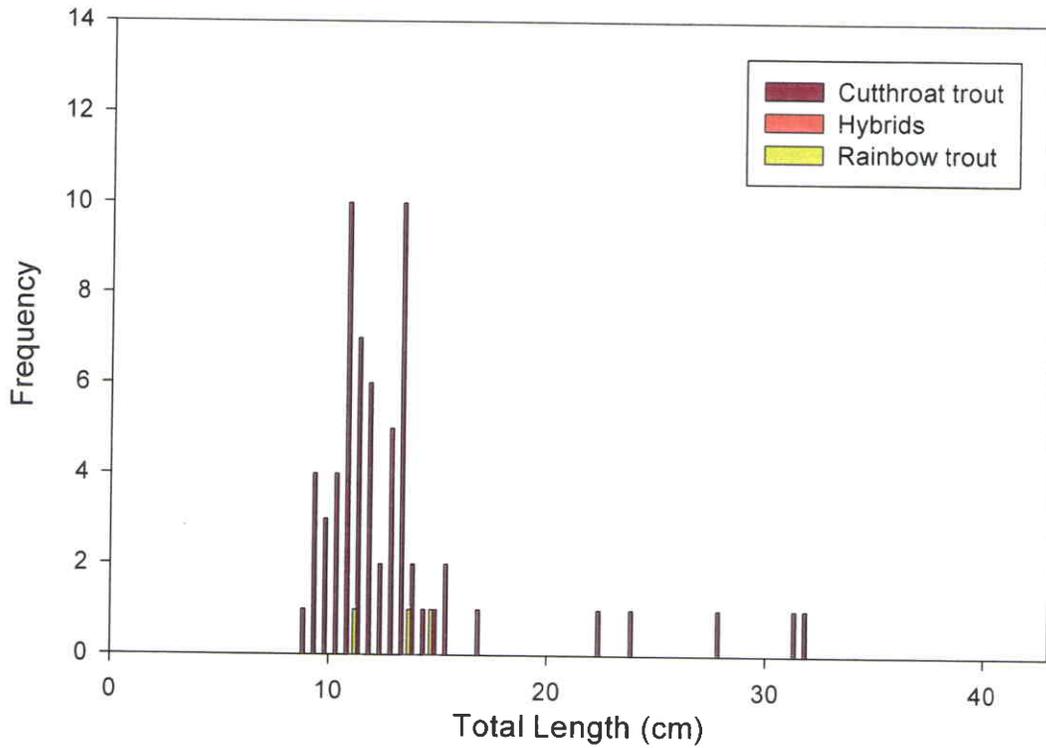


Figure 4. Length frequency of trout from the combined Eccles Creek stations, 2007.

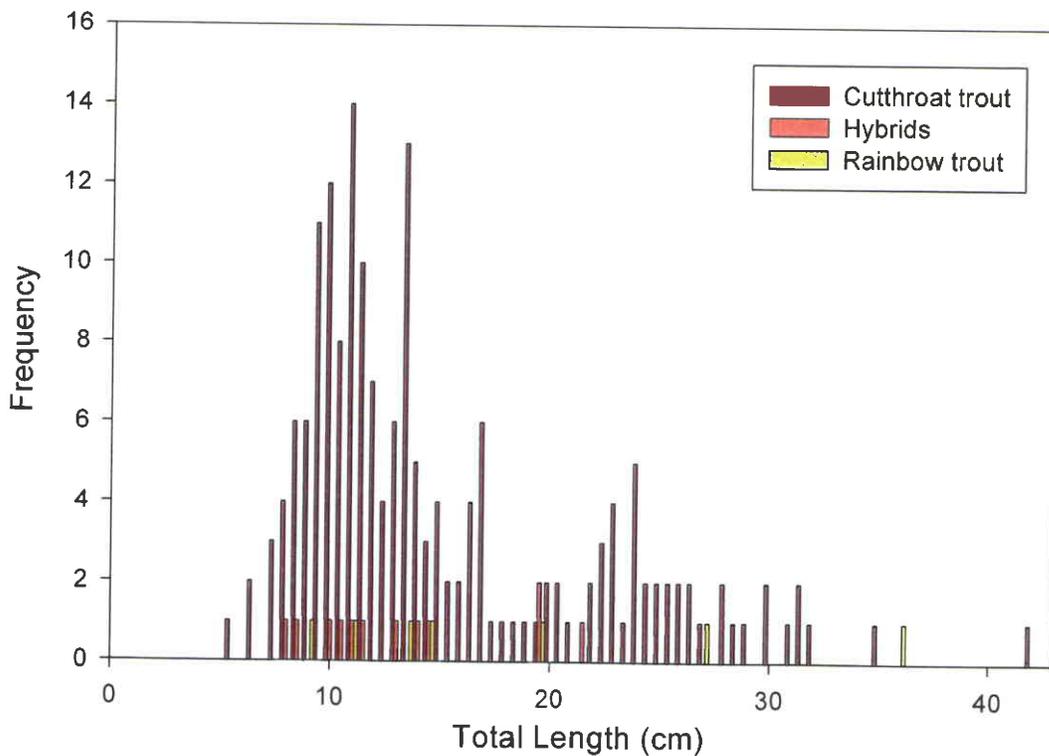


Figure 5. Length frequency of Cutthroat trout from the Lower Eccles Creek Station, 2010.

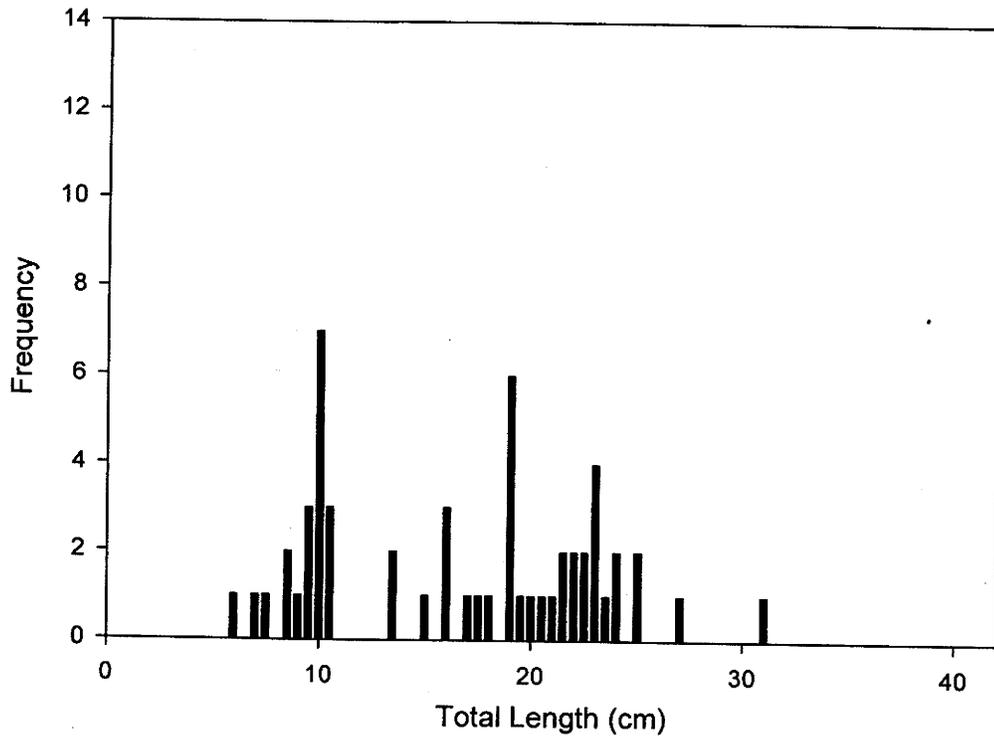


Figure 6. Length frequency of cutthroat trout from the Middle Eccles Creek Station, 2010.

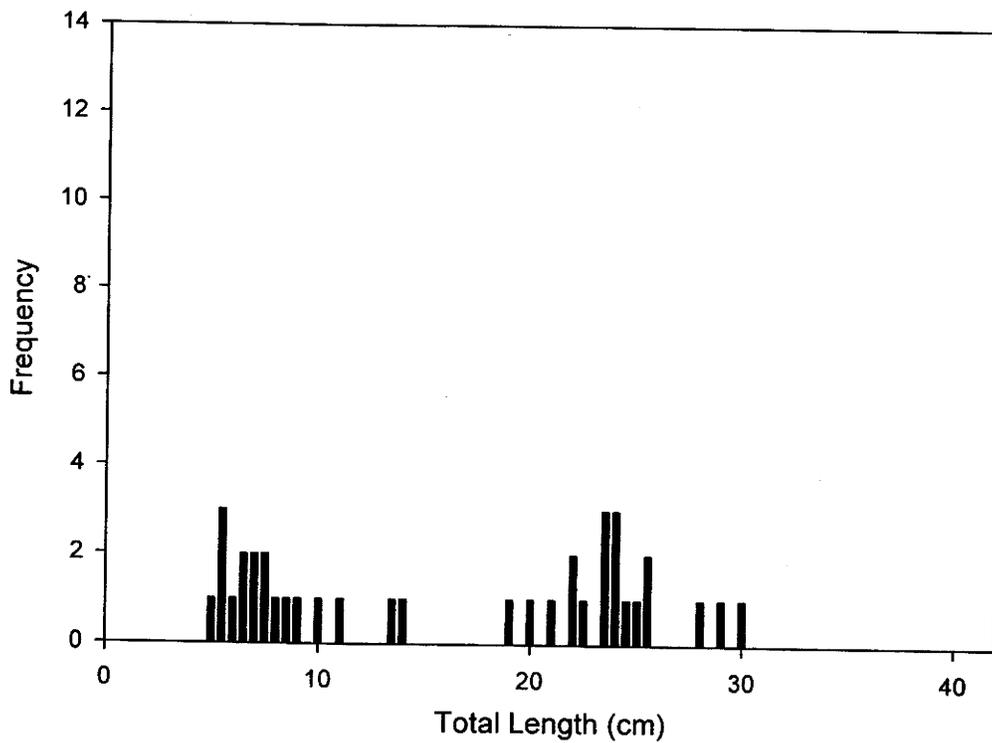


Figure 7. Length frequency of cutthroat trout from the Upper Eccles Creek Station, 2010.

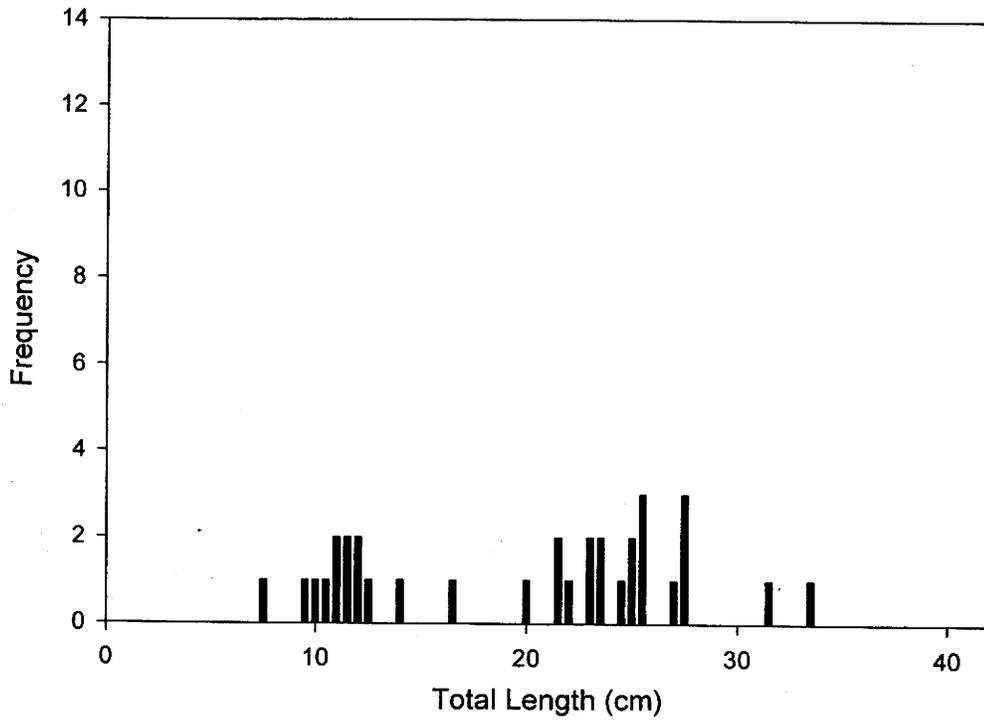
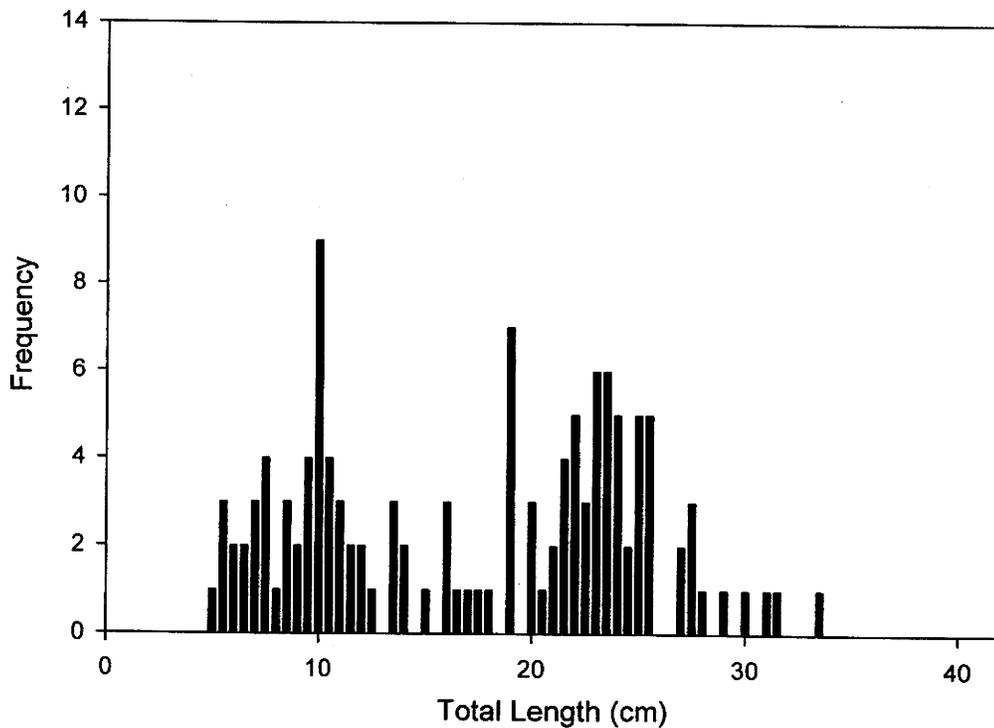


Figure 8. Length frequency of cutthroat trout from the combined Eccles Creek stations, 2010.



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