APPENDIX D – ROCK TPA BIOLOGICAL SAMPLING 2011: MACROINVERTEBRATE AND PERIPHYTON RESULTS

Appendix D is based report prepared for the DEQ by Watershed Consulting, LLC, Dec. 2011.

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D1.0 STUDY OBJECTIVE AND AREA

This report summarizes results of 2011 biological sampling and analysis conducted in 8 stream reaches of the Rock TMDL Planning Area (TPA). Analysis of the resulting data serves to support the Montana Department of Environmental Quality (DEQ) Total Maximum Daily Load (TMDL) program by documenting the aquatic macroinvertebrate and periphyton taxa present in each project reach. The taxa present are used as supporting information for TMDL development.

Following MTDEQ Standard Operating Procedures (SOP) for both periphyton and macroinvertebrates, a qualified team collected samples and other field data between August 8th and 12th, 2011. Field crew, consisting of the Project Manager and a field technician, followed the EMAP protocol for macroinvertebrate sampling and the Peri-1*mod* method for periphyton. Additional data collected included aquatic vegetation composition, amount, color and condition, water chemistry indicators such as dissolved oxygen (DO), pH, specific conductivity (SC), and air and water temperature, as well as digital photos upstream, downstream and across each reach. All samples were delivered to Rithron Associates of Missoula, a qualified taxonomy laboratory, for analysis. All samples were analyzed for the taxa present and reports provided to DEQ.

Project reaches are listed in **Table D-1** and locations are shown in **Figure D-1**.

Table D-1. Rock TPA Reaches

Reach ID	Stream Name	Date Sampled	F transect Latitude	F transect Longitude
ANTE 08-01	Antelope Creek	8/12/11	46.2744	-113.4190
ANTE 21-03	Antelope Creek	8/10/11	46.2670	-113.4989
QUTZ 08-01 (u.s)	Quartz Gulch (u.s.)	8/09/11	46.3156	-113.6118
QUTZ 08-01 (d.s)	Quartz Gulch (d.s.)	8/09/11	46.3162	-113.6103
UWIL 15-01	Upper Willow Creek	8/08/11	46.3380	-113.5270
UWIL 11-05	Upper Willow Creek	8/08/11	46.4459	-113.4931
WFRK 14-03	West Fork Rock Creek	8/10/11	46.1930	-113.7089
WFRK 30-02	West Fork Rock Creek	8/10/11	46.2329	-113.5669

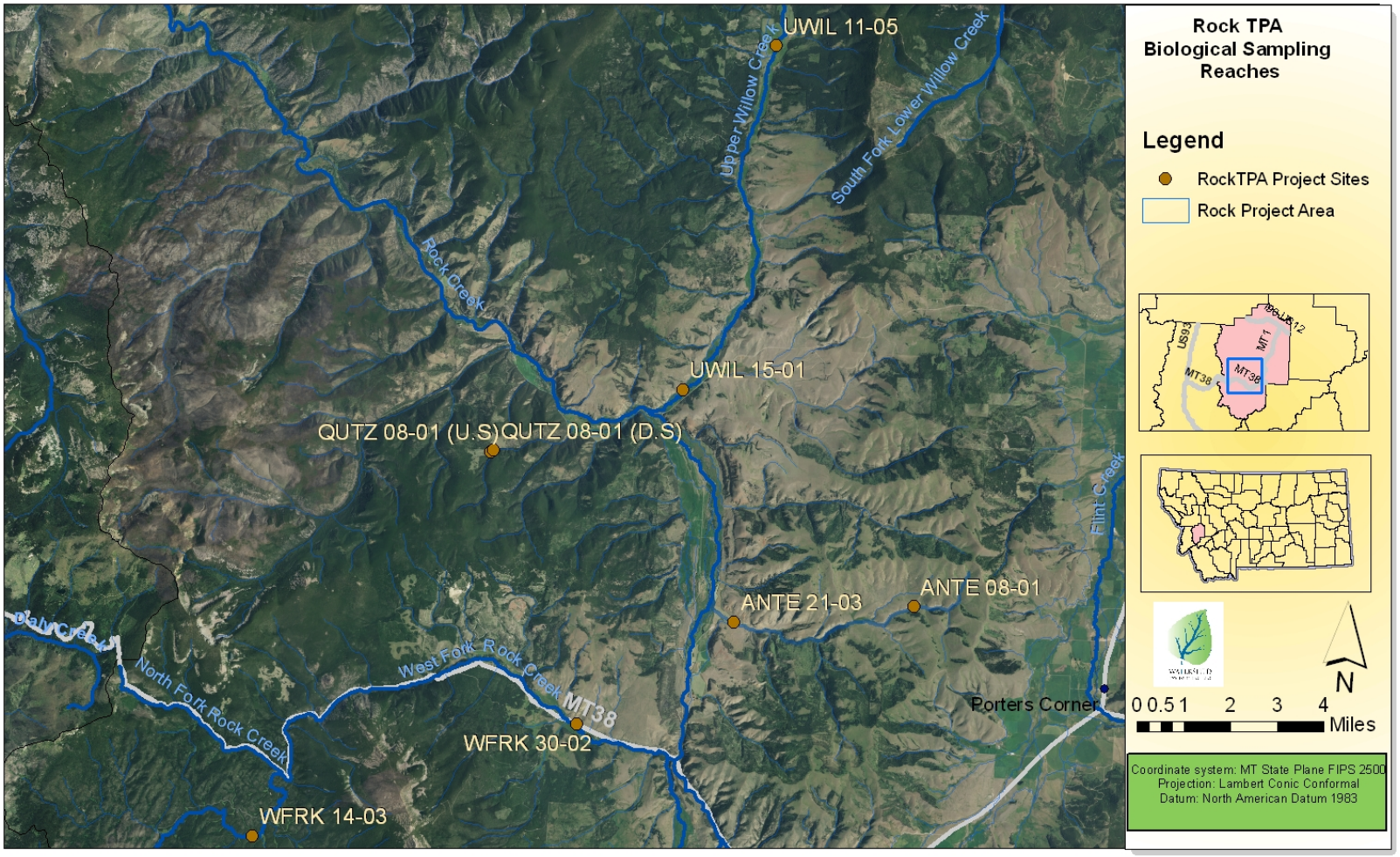


Figure D-1. Rock TPA Sampled Reaches

D2.0 METHODS

Sample sites for this study were selected by DEQ personnel as part of a larger TMDL planning effort for the Rock TPA. Simultaneous sediment/habitat TMDL assessments occurring in the Rock TPA provided site access information, including coordinates for the upstream and downstream ends of each reach to be sampled. Two sites in Williams Gulch were not sampled due to lack of access. Changes in the sampling plan were confirmed by the DEQ project officer.

The Rock project area was visited between August 8th and 12th for sample collection. No inclement weather was observed during the sampling period. Both reaches of the same stream were visited the same day, beginning with the downstream site. An exception was Antelope creek, whose upstream reach was sampled two days after the downstream reach due to access issues. Following protocol outlined in SOP's for macroinvertebrate (Montana Department of Environmental Quality, Water Quality Planning Bureau, 2012) and periphyton (Montana Department of Environmental Quality, 2011) sampling, our team identified a suitable F transect point within the given stream reach where water chemistry data were collected: pH, DO, SC and temperatures. F transects were chosen based on their representation of overall stream conditions. In cases where a reach showed different characteristics between their upstream and downstream portions, the F transect was chosen so that both stream characteristics would be included in the total sampled area. Reach lengths represented 40 times the average wetted width at the F transect.

Macroinvertebrate composite samples were collected using a 500 micron kick net across 11 transects (A-K) and preserved in 99% ethanol, provided by the taxonomy contractor. The 50mL periphyton samples were sub-sampled from a composite of 11 transects and preserved with formalin. Samples were delivered to the qualified taxonomy laboratory upon completion of the field visit. More details of the sample collection procedure followed can be found in the SOPs (Montana Department of Environmental Quality, 2011; Montana Department of Environmental Quality, Water Quality Planning Bureau, 2012).

Laboratory results were provided first to DEQ personnel to be processed and entered into the appropriate data bases. For each reach DEQ personnel used the O/E model to calculate the ratio of the number of taxa observed (O) in the collected sample to the number expected (E) in that site type. O/E scores relate to stream impairment as shown in **Table D-2**. The macroinvertebrate metric is a general impairment indicator which can be affected by both pollutants and non-pollutants.

Table D-2. RIVPACS Impairment classes

RIVPACS	Impairment Class
0.80 - 1.20	Unimpaired
0.44 - 0.79	Moderate
<0.44	Severe

Periphyton results were reported with an impairment probability percentage. Scores greater than 51% are considered impaired for sediment. These results, along with observations for each reach are provided below.

D2.1 FISH COVER/OTHER

Using the Fish Cover/Other form provided by DEQ, field observations of aquatic vegetation were made between each transect. A total of 11 sub-reaches were documented, which included an inter-transect distance upstream of the upstream K transect. Data collected included a presence score for microalgae, filamentous algae, macrophytes and moss, as well as their color, condition, and thickness.

The habitat type (Riffle, Run/Glide, Pool) for periphyton sample locations were not documented in the field for this assessment. Using field notes and photographs the relative distribution of habitat types was estimated for all field sites and reflect our best estimate of periphyton habitat types sampled, expressed as a percent.

Presence scores for each of the periphyton types were averaged and then rounded to the nearest whole number score. These scores are represented in our findings by their percent (e.g. sites averaging a 1 for microalgae are presented as <10%). A similar averaging approach was used to determine an overall color, condition and length for each periphyton type. In cases where equal numbers were found for two different qualities (for example 5 green and 5 light green color microalgae), the 11th data point, field notes and photographs were used to make a final determination.

Microalgae: Color photographs provided in the periphyton SOP (Montana Department of Environmental Quality, 2011) were the primary guidance used to determine cover scores. The photographs clearly show that as scores approach 4 stream substrates increasingly become covered in mats of material, appearing to “clog”. Scores of 0 or 1, by contrast, indicate “clean” substrate. Often in western Montana streams, substrate can appear “clean” but will be slippery, which would indicate the presence of microalgae. Slippery but “clean” substrate was generally scored as 1.

Moss: Generally moss in streams appears dark, and is often noted in the Fish Cover/Other form as DBB. This notation does not necessarily indicate a decadent vegetative state, but visual appearance. Most often dark-looking moss had bright green new growth.

D3.0 RESULTS

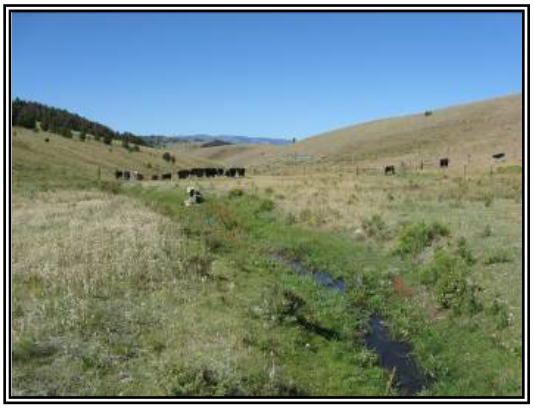
Results of this sampling project are presented by reach in the following subsections. DEQ personnel have run macroinvertebrate and periphyton results through their data entry protocol and have run biometric models, resulting in impairment probability scores (periphyton) and observed/expected ratios (macroinvertebrates) for each stream reach. Those results are presented here along with a summary of site visit information and a short discussion of each reach based on field notes.

General water quality conditions and site visit information are provided in **Table D-3**.

Table D-3. Rock TPA Site Visit Summary Data

Reach ID	Sample Date	Reach Length (ft)	Water temp (°C)	pH	SC (us/cm)	DO (mg/L)
ANTE 08-01	8/12	150	15	8.33	145.7	11.7
ANTE 21-03	8/10	150	13	8.58	321.0	14.0
QUTZ 08-01 (U.S)	8/09	150	11	7.46	118.8	13.4
QUTZ 08-01 (D.S)	8/09	200	11	7.54	64.3	14.1
UWIL 15-01	8/08	290	13	7.64	52.7	14.4
UWIL 11-05	8/08	440	16	7.68	38.4	13.3
WFRK 14-03	8/10	950	10	7.89	22.0	13.7
WFRK 30-02	8/10	1400	12	7.73	25.7	14.8

D3.1 ANTE 08-01



This stream reach is little more than a slow trickle, flowing through a heavily used cattle pasture just downstream from a corral. The channel was poorly defined due to trampling. Judging from non-riparian vegetation growing almost in the center of the stream (curly dock, pasture grasses), it is likely dry in many years. A mat of sediment and worm castings were common on "streambanks" and sometimes coated the entire channel. A cow pie was noted in the stream at transect A.

There was inadequate flow in this reach for a kick net; substrate was collected by hand and hand-washed in the net for 30 seconds. We avoided highly trampled areas and sampled where channel was most well-defined. There was no visible sign of periphyton at the time of sampling. Laboratory results confirm our visual assessments of the stream as impaired, likely due to sediment inputs. An impairment summary is provided in **Table D-4** and summary results of the Fish Cover/Other form are presented in **Table D-5.**

Table D-4. Ante 08-01 Periphyton and Macroinvertebrate Impairment Class Summary

Reach ID	Periphyton		Macroinvertebrate	
	Impairment Probability	Impairment Class	O/E Score	Impairment Class
ANTE 08-01	72.45%	Impaired	0.28	Severe

Table D-5. Ante 08-01 Periphyton Cover and Sample Habitat Summary

Characteristic	Periphyton Cover				Sample Habitat (%)		
	Microalgae	Filamentous Algae	Macrophytes	Moss	Riffle	Run/Glide	Pool
Presence	Absent	Absent	Absent	Absent	0%	100%	0%
Color	----	----	----	----			
Condition	----	----	----	----			
Thickness/ Length	----	----					

D3.2 ANTE 21-03

This reach is only an active channel from its upstream end to an irrigation ditch halfway down the reach. Head gates divert water in two directions above the lower field (which from aerial photographs may appear to contain a stream). The stream at time of sampling was cloudy, deeply incised and buffered by dense mats of grasses.

The stream substrate was small gravels (4-32mm) or clay. Thick grass creates a small undercut. Stream remains cool due to riparian cover but rocks have no "slime" to them. This reach showed a severe impairment class for macroinvertebrates and impairment for periphyton. An impairment summary is provided in **Table D-6** and summary results of the Fish Cover/Other form are presented in **Table D-7.**

Table D-6. Ante 21-03 Periphyton and Macroinvertebrate Impairment Class Summary

Reach ID	Periphyton		Macroinvertebrate	
	Impairment Probability	Impairment Class	O/E Score	Impairment Class
ANTE 21-03	55.66%	Impaired	0.37	Severe

Table D-7. Ante 21-03 Periphyton Cover and Sample Habitat Summary

Characteristic	Periphyton Cover				Sample Habitat (%)		
	Microalgae	Filamentous Algae	Macrophytes	Moss	Riffle	Run/Glide	Pool
Presence	Absent	Absent	Absent	Absent	0%	100%	0%
Color	----	----	----	----			
Condition	----	----	----	----			
Thickness/ Length	----	----					

D3.3 WFRK 14-03

This wide and sinuous stream segment flows through an open meadow. An old fence crosses the stream just upstream of K and pieces of an old bridge and other structures were seen in the stream in several locations. Substrate varied from deep sediment deposits, deep pools, and gravels. The only visible current influence here would be a fishing campsite near A. About 20 cutthroat trout were seen by the remains of an old structure in the stream. Macroinvertebrate results showed a severe impairment class from the RIVPACS scoring. Periphyton was shown to be unimpaired. An impairment summary is provided in **Table D-8** and summary results of the Fish Cover/Other form are presented in **Table D-9.**

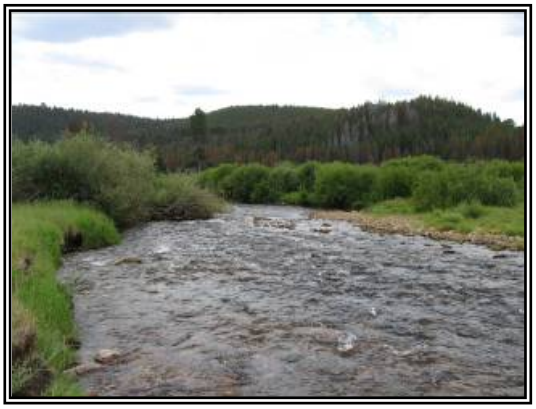
Table D-8. WFRK 14-03 Periphyton and Macroinvertebrate Impairment Class Summary

Reach ID	Periphyton		Macroinvertebrate	
	Impairment Probability	Impairment Class	O/E Score	Impairment Class
WFRK 14-03	25.49%	Unimpaired	0.40	Severe

Table D-9. WFRK 14-03 Periphyton Cover and Sample Habitat Summary

Characteristic	Periphyton Cover				Sample Habitat (%)		
	Microalgae	Filamentous Algae	Macrophytes	Moss	Riffle	Run/Glide	Pool
Presence	10-40%	10-40%	10-40%	<10%	0%	75%	25%
Color	Brown	Green	Green	Green			
Condition	Growing	Growing	Growing	Growing			
Thickness/ Length	Thin	Long					

D3.4 WFRK 30-02



The downstream end of this reach is just upstream of a bridge. With a 1400 foot length, our sampling reach encompassed almost the entire stream segment. The upper reaches (G-K) are in a straightened section adjacent to highway 38. Riparian vegetation is reduced on river left in this straight section. Much moss was seen throughout the reach, which had large riffle sections divided by deeper sandy deposits.

As with its upstream reach, impairment for macroinvertebrates was just barely in the severe impairment class while periphyton impairment probability was low. An impairment summary is provided in **Table D-10** and summary results of the Fish Cover/Other form are presented in **Table D-11.**

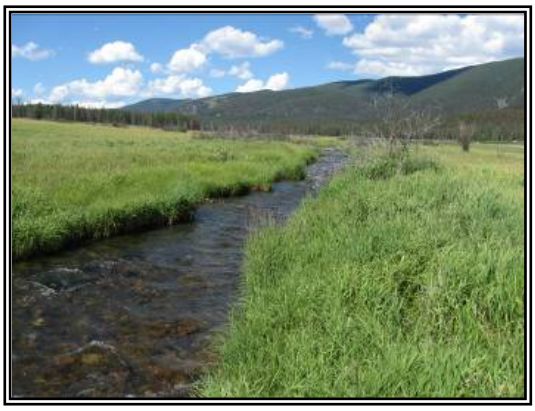
Table D-10. WFRK 30-02 Periphyton and Macroinvertebrate Impairment Class Summary

Reach ID	Periphyton		Macroinvertebrate	
	Impairment Probability	Impairment Class	O/E Score	Impairment Class
WFRK 30-02	32.50%	Unimpaired	0.43	Severe

Table D-11. WFRK 30-02 Periphyton Cover and Sample Habitat Summary

Characteristic	Periphyton Cover				Sample Habitat (%)		
	Microalgae	Filamentous Algae	Macrophytes	Moss	Riffle	Run/Glide	Pool
Presence	<10%	10-40%	<10%	40-75%	60%	40%	0%
Color	Green/ Light Brown	Green	Green	Dark Brown/ Black			
Condition	Growing	Growing	Growing	Growing			
Thickness/ Length	Thin	Long					

D3.5 UWIL 11-05



Haying dominates land uses throughout this reach. Willow and other shrubs are infrequent along banks, with several decadent representatives. Overhanging grasses provide some shade habitat. The reaches above and below this one have more vigorous riparian shrub growth. Stream has low sinuosity, with current and past land uses as the primary influences on the stream. Cobble substrate and riffles were common. Both periphyton and macroinvertebrates scored as impaired. An impairment summary is provided in **Table D-12** and summary results of the Fish Cover/Other form are presented in **Table D-13.**

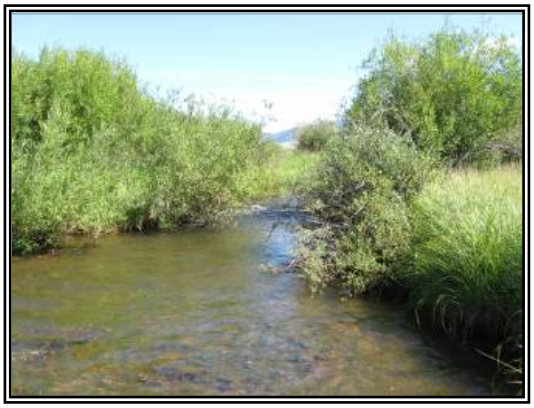
Table D-12. UWIL 11-05 Periphyton and Macroinvertebrate Impairment Class Summary

Reach ID	Periphyton		Macroinvertebrate	
	Impairment Probability	Impairment Class	O/E Score	Impairment Class
UWIL 11-05	55.14%	Impaired	0.57	Moderate

Table D-13. UWIL 11-05 Periphyton Cover and Sample Habitat Summary

Characteristic	Periphyton Cover				Sample Habitat (%)		
	Microalgae	Filamentous Algae	Macrophytes	Moss	Riffle	Run/Glide	Pool
Presence	10-40%	10-40%	<10%	<10%	75%	25%	0%
Color	Light Brown	Green	Green	Dark Brown/ Black			
Condition	Growing	Growing	Growing	Growing			
Thickness/ Length	Thin	Long					

D3.6 UWIL 15-01



Agricultural land use surrounds the creek and grazing is evident close to the reach. The reach supports a mature riparian vegetation community in healthy condition. All ages of willow were present, providing good cover along much of the reach. Thick grass cover has impeded weeds. Cobble substrate was dominant in this mostly run/glide system.

Moderate impairment was determined for macroinvertebrates while periphyton results fell in the unimpaired class. An impairment summary is provided in **Table D-14** and summary results of the Fish Cover/Other form are presented in **Table D-15.**

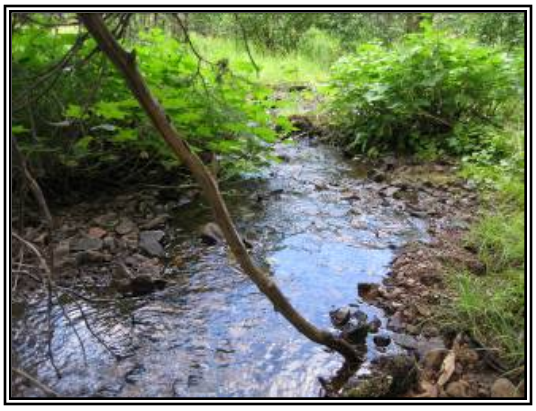
Table D-14. UWIL 15-01 Periphyton and Macroinvertebrate Impairment Class Summary

Reach ID	Periphyton		Macroinvertebrate	
	Impairment Probability	Impairment Class	O/E Score	Impairment Class
UWIL 15-01	37.43%	Unimpaired	0.60	Moderate

Table D-15. UWIL 15-01 Periphyton Cover and Sample Habitat Summary

Characteristic	Periphyton Cover				Sample Habitat (%)		
	Microalgae	Filamentous Algae	Macrophytes	Moss	Riffle	Run/Glide	Pool
Presence	10-40%	10-40%	<10%	<10%	25%	75%	0%
Color	Green/Light Brown	Green	Green	Green			
Condition	Growing	Growing	Growing	Growing			
Thickness/ Length	Thin	Long					

D3.7 QUTZ 08-01 (U.S)



Past activity in this gulch includes logging and mining. It appears mitigation work was also done here, evidenced by erosion control fabric placed on streambanks and within the channel at a gradient change. A pond was created further downstream possibly for sediment catchment. Despite this activity, this reach appears to be in a natural condition, just below the forested area in a transitional meadow. This channel likely has a very flashy character. Mosses and macrophytes appear to do well while microalgae are rarely present and usually in the form of dark and small colonies on some rocks.

At transect G some debris has created a small pool where macros and moss are growing more than usual, with minimal sign of microalgae. Both macroinvertebrates and periphyton showed impairment based on identified taxa. An impairment summary is provided in **Table D-16** and summary results of the Fish Cover/Other form are presented in **Table D-17.**

Table D-16. QUTZ 08-01 (U.S.) Periphyton and Macroinvertebrate Impairment Class Summary

Reach ID	Periphyton		Macroinvertebrate	
	Impairment Probability	Impairment Class	O/E Score	Impairment Class
QUTZ 08-01 (U.S.)	72.45%	Impaired	0.78	Moderate

Table D-17. QUTZ 08-01 (U.S.) Periphyton Cover and Sample Habitat Summary

Characteristic	Periphyton Cover				Sample Habitat (%)		
	Microalgae	Filamentous Algae	Macrophytes	Moss	Riffle	Run/Glide	Pool
Presence	<10%	Absent	<10%	10-40%	60%	40%	0%
Color	Dark Brown/Black	Green/Light Brown	Green	Dark Brown/ Black			
Condition	Growing	Growing	Growing	Growing			
Thickness/ Length	Thin	Long					

D3.8 QUTZ 08-01 (D.S)

This reach is below a sharp slope break mentioned in the previous reach, where the creek temporarily subs under a pile of rocks, and just upstream of a constructed pond. The stream is narrow and cobble-dominated with little periphyton growth observed except for one filamentous algae specimen at transect E. This site is best accessed from an old logging road not clearly visible from the Forest Service road. Periphyton were found to be impaired, while macroinvertebrates were determined to be unimpaired based on collected taxa. An impairment summary is provided in **Table D-18** and summary results of the Fish Cover/Other form are presented in **Table D-19.**

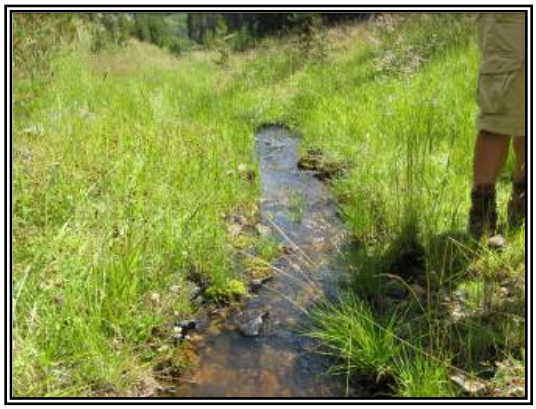


Table D-18. QUTZ 08-01 (D.S.) Periphyton and Macroinvertebrate Impairment Class Summary

Reach ID	Periphyton		Macroinvertebrate	
	Impairment Probability	Impairment Class	O/E Score	Impairment Class
QUTZ 08-01 (D.S)	95.00%	Impaired	0.85	Unimpaired

Table D-19. QUTZ 08-01 (D.S.) Periphyton Cover and Sample Habitat Summary

Characteristic	Periphyton Cover				Sample Habitat (%)		
	Microalgae	Filamentous Algae	Macrophytes	Moss	Riffle	Run/ Glide	Pool
Presence	<10%	<10%	<10%	<10%	10%	90%	0%
Color	Dark Brown/ Black	Green/ Light Brown	Green	Dark Brown/ Black			
Condition	Growing	Growing	Growing	Growing			
Thickness/ Length	Thin	Short					

D4.0 SUMMARY

All stream reaches with exception of the West Fork Rock Creek sites showed impairment in either macroinvertebrates or periphyton, with the Antelope Creek sites, upper Quartz Creek and Upper Willow 11-05 showing impairment in both based on taxa observed in laboratory analysis. A summary table of impairment is provided in **Table D-20** below.

Table D-20. Stream Reach Impairment Summary

Reach ID	Macroinvertebrate	Periphyton
ANTE 08-01	Severely Impaired	Impaired
ANTE 21-03	Severely Impaired	Impaired
QUTZ 08-01 (U.S)	Moderately Impaired	Impaired
QUTZ 08-01 (D.S)	Unimpaired	Impaired
UWIL 15-01	Moderately Impaired	Unimpaired
UWIL 11-05	Moderately Impaired	Impaired
WFRK 14-03	Severely Impaired	Unimpaired
WFRK 30-02	Severely Impaired	Unimpaired

D5.0 REFERENCES

Montana Department of Environmental Quality. 2011. Periphyton Standard Operating Procedure. Helena, MT: Montana Department of Environmental Quality. WQPVWQM-010.

Montana Department of Environmental Quality, Water Quality Planning Bureau. 2012. Sample Collection, Sorting, and Taxonomic Identification of Benthic Macroinvertebrates Standard Operating Procedure. Helena, MT: Montana Department of Environmental Quality. WQPBWQM-009. http://deq.mt.gov/wqinfo/QAProgram/PDF/SOPs/WQPBWQM-009.pdf. Accessed 7/9/2013.