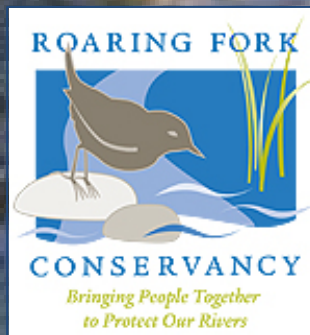


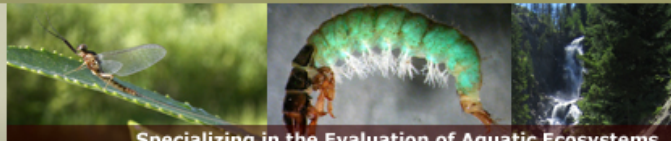
A Review of Aquatic Life and Stream Health in the Roaring Fork Watershed



and



Timberline Aquatics, Inc.



July 19, 2012

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ROARING FORK WATERSHED PLAN

Acknowledgments

Roaring Fork Conservancy wishes to thank John Marlow for funding and Chris Theel, Colorado Department of Public Health and Environment for funding and project guidance; Jane Clancy for editing; and the following volunteers who helped with the sampling: Paul D'Amato, David DiPietro, Philip Halliwell, Jennifer Long, Randy McConnell, Chris Neral, Nick Sampson, Laura Taylor, and Chris Ullrich.

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Executive Summary

Biomonitoring, the use of an indicator species or community to assess biological integrity, provides a valuable tool that can be used to evaluate the quality and condition of aquatic ecosystems over time (Plafkin et al. 1989, Barbour et al. 1999, Paul et al. 2005). Benthic macroinvertebrates, aquatic insects large enough to be seen without a microscope, are an ideal bioindicator because of their limited mobility, relatively long aquatic life stage, high population densities, and sensitivity to disturbance (Herricks 1995, Ward et al. 2002). In the fall of 2011, the Roaring Fork Conservancy (RFC) teamed up with the Water Quality Control Division (WQCD) of the Colorado Department of Public Health and Environment (CDPHE) to select and sample twenty sites in the Roaring Fork Watershed, collecting macroinvertebrates to assess overall stream health in the Roaring Fork Valley. RFC worked with Timberline Aquatics, Inc to analyze these data and produce this report.

It is beneficial to use several biotic indices, or metrics, when analyzing collection data because certain taxa survive and sometimes thrive in the presence of various contaminants. To better understand both healthy and adversely impacted sites, an analysis of multiple metrics was used along with comparisons to other study sites and past results at the same site. In the fall of 2010, the CDPHE published guidelines specific to the state of Colorado for benthic macroinvertebrate sampling and analysis using a Multi-Metric Index (MMI). MMI provides a rating of overall stream health based on presence, absence, and abundance of specific macroinvertebrates. Reference sites throughout the state provide guidelines for ideal conditions on which to compare each stream based on ecological conditions such as elevation, gradient, and geology. Each metric is assigned a threshold for attainment and impairment; stream reaches falling between these thresholds require additional analysis.

This assessment of stream health found that most streams sampled in the Roaring Fork Watershed met or surpassed the MMI standards for healthy aquatic conditions. Of the twenty sites sampled, only two sites are considered impaired (Cattle Creek site 12719 and Roaring Fork site 12783) while one site (Roaring Fork site 12784) fell in the gray area between healthy and impaired. The highest MMI score in biotype 1 was registered at Thompson Creek (site 12799c), a tributary to the Crystal River, and the second highest score occurred within upper Cattle Creek (site 12725). In biotype 2, the highest MMI score was recorded at the Crystal River (site 12731b). These sites contained some of the best aquatic conditions for macroinvertebrates, a good indicator of overall stream health.

Although 2011 produced strong results for Roaring Fork Rivers, the story does not end here. Continued monitoring is essential over time to evaluate changes in the ecosystem such as increasing water demands, or changes in land use practices. A long term monitoring program would also provide a better understanding of the impact of human disturbances on both healthy and impaired streams. Continued collections at pristine sites, with minimal human impact, provide a valuable standard to compare natural yearly variations in all streams. Likewise, persistent studies in impaired areas are necessary to identify the sources of stress and potential means of mitigation. Biomonitoring with benthic macroinvertebrates provides a

valuable glimpse into the complexity of long- and short-term stream health, and based on these metrics, the Roaring Fork Watershed shows an abundance of thriving aquatic conditions.

Introduction

In 2011, with the help of the Water Quality Control Division (WQCD) of the Colorado Department of Public Health and Environment (CDPHE), Roaring Fork Conservancy (RFC) selected 20 sites to sample in the Roaring Fork River Watershed (Figure 1). Sites were selected on the Roaring Fork and Crystal Rivers, and on Brush, Capitol, Snowmass, Thompson, Coal, Cattle, and West Sopris Creeks. Benthic macroinvertebrate samples were collected by both RFC staff and WQCD staff in the fall. The results of data analysis and interpretation from this sampling are included in this report.

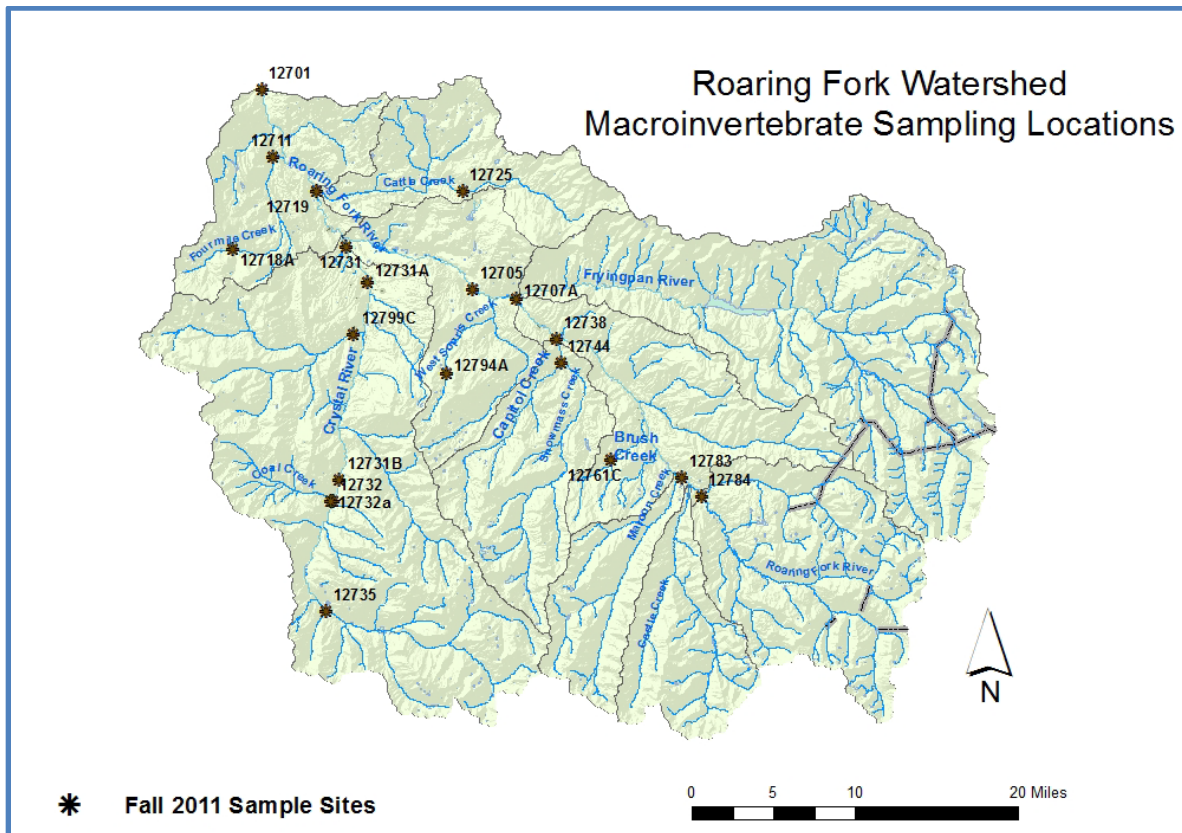


Figure 1: Roaring Fork Watershed Fall, 2011 macroinvertebrate sampling locations.

Background

Biomonitoring provides a valuable tool that can be used to evaluate the quality and condition of aquatic ecosystems over time (Plafkin et al. 1989, Barbour et al. 1999, Paul et al. 2005). Evolution and ecological processes have resulted in benthic macroinvertebrate communities with specific adaptations to their environment. Sensitivity of benthic macroinvertebrates to disturbance can exist at a structural (species/taxon) level and/or functional (trophic) level. Different macroinvertebrate taxa may also respond to disturbance in different ways. These unique features provide an opportunity to identify the influences of various types of disturbances within a system. Because of their limited mobility, relatively long aquatic life stage, high population densities, and sensitivity to disturbance, benthic macroinvertebrates

have become a preferred biological indicator for the assessment of biological integrity (Herricks 1995, Ward et al. 2002).

Because certain taxa can survive or even thrive in the presence of various contaminants, it becomes necessary to employ the use of several biotic indices (metrics) in the analysis of the data. Bonada et al. (2006) found that the problems associated with individual biomonitoring tools (metrics) can be reduced by using a multiple metric index. In this study, the analysis of samples and comparison between sampling sites provided information regarding areas of greatest impact within the study area.

Selected Macroinvertebrate Metrics

Multi-Metric Index (MMI)

In the fall of 2010, the CDPHE published specific guidelines for benthic macroinvertebrate sampling and analysis to assist in the evaluation of aquatic life in the State of Colorado (Colorado Department of Public Health and Environment 2010). These guidelines described specific protocols for the analysis of benthic macroinvertebrate data using a Multi-Metric Index (MMI). These metrics were employed at the appropriate sites to assist in data analysis.

The MMI provides a single index score based on five or six equally weighted metrics. The group of metrics used in MMI calculations depends on the location of the sampling site and corresponding Biotype (Mountains, Transitional, or Plains). Each of the metrics used in the MMI produces a value that is adjusted to a scale from 1 to 100 based on the range of metric scores found at “reference sites” in the state of Colorado.

In this study, all sites were contained within two Biotypes. Biotype 1 includes streams in the Transitional Zone between higher elevation and low elevation habitats in Colorado. Sites within Biotype 2 are considered high gradient, mountain streams. Metrics currently used for Biotype 1 include: Percent Non-insect Taxa, EP Taxa, Percent Chironomidae, Percent Sensitive Plains Families, Predator-Shredder Taxa, and Clinger Taxa. Metrics currently recommended for Biotype 2 include: Total Taxa, Predator and Shredder Taxa, Percent Ephemeroptera, Beck’s Biotic Index, and Clinger Taxa. The thresholds for MMI scores that determine impairment or attainment for aquatic life use are:

<u>Biotype</u>	<u>Attainment Threshold</u>	<u>Impairment Threshold</u>
Transition (Biotype 1)	>52	<42
Mountains (Biotype 2)	>50	<42

Metric scores that fall between the thresholds for attainment and impairment require further evaluation using two additional metrics, the Shannon Diversity (Diversity) and Hilsenhoff Biotic Index (HBI), in order to determine if the site is in attainment or impaired for aquatic life use.

Hilsenhoff Biotic Index (HBI)

Most of this metric's value lies in detection of organic pollution, but it has also been used to evaluate aquatic conditions in a variety of other circumstances. The HBI was originally developed using macroinvertebrate taxa from streams in Wisconsin; therefore, it may require regional modifications (Hilsenhoff 1988). Although the value indicating a certain water quality rating may vary among regions, comparison of the values produced within the same system should provide information regarding sites with impact from nutrient enrichment. Values for the HBI range from 0.0 to 10.0, and increase as water quality decreases.

Shannon Diversity (Diversity)

Diversity values are used to detect changes in macroinvertebrate community structure. In unpolluted waters, diversity values typically range from near 3.0 to 4.0. In polluted waters this value is generally less than 1.0.

Thresholds for these metrics are:

<u>Biotype</u>	<u>HBI</u>	<u>Diversity</u>
Transition (Biotype 1)	<5.4	>2.4
Mountains (Biotype 2)	<5.1	>3.0

Additional Individual Metrics

Additional individual metrics were applied and compared among sites in order to assist in the evaluation of aquatic life in the study area. The following metrics were selected because they are widely used in western streams and could be of particular value to this study area.

Taxa Richness

Taxa Richness is often used to provide an indication of habitat adequacy and water quality. Taxa Richness, or the total spectrum of taxa groups present at a given site, will generally decrease when exposed to decreasing water quality or habitat degradation (Resh and Jackson 1993). This metric is reported as the total number of identifiable taxa collected from each sampling location. It is utilized as part of the Biotype 2 MMI calculation.

Ephemeroptera Plecoptera Trichoptera (EPT)

The design of this metric is based on the assumption that the orders of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) are generally more sensitive to pollution and environmental stress than other benthic macroinvertebrate orders (Lenat 1988). This number will vary naturally among river systems, but it can be an excellent indicator of disturbance within a specific drainage. The EPT value is expected to decrease in response to a variety of stressors including nutrients (Wang et al. 2007).

Clinger Taxa

This metric is included in both the Biotype 1 and Biotype 2 MMI calculations. Excessive sedimentation, rapid changes in discharge, or excessive algal growth can cause a reduction in this metric value (Hughes & Brossett 2009).

Results

A wide range of MMI scores were produced from sample sites in the study area, and some of the highest values were achieved at sites located on tributaries to the larger rivers in the watershed (Tables 1 and 2, Figures 2 to 4). Most sites had healthy conditions for aquatic life. Seventeen of the sample sites produced MMI scores surpassing the threshold for attainment of aquatic life use. This suggested that suitable aquatic conditions and relatively healthy benthic macroinvertebrate communities were present at most sites. Of the three sites that did not meet the initial CDPHE requirements for aquatic life use, two sites (Cattle Creek site 12719 and Roaring Fork site 12783) produced scores below the threshold for impairment. One site (Roaring Fork site 12784) produced an MMI score that fell within the “gray zone,” between attainment and impairment (Figures 2 and 3). Auxiliary metric (HBI and Diversity) values indicated that this site was in attainment for aquatic life use.

The highest MMI score for sites located in Biotype 1 (82.8) was obtained from data collected in Thompson Creek, a tributary of Crystal River (Table 1, Figure 3). In Biotype 2, the highest MMI score (86.0) was found at the Crystal River (site 12731B), indicating that this site contained some of the best aquatic conditions for benthic macroinvertebrates in the study area (Table 2, Figure 4). In general, MMI scores and additional data analysis tools suggested that the majority of aquatic habitat in the study area provided adequate conditions for aquatic life. The results for each site are discussed in more detail.

Table 1: Biotype 1 metric results. Sites with multiple samples are distinguished by Rep number or agency. MMI scores which did not meet the CDPHE requirements for attainment of aquatic life use are reported in red. Auxiliary metrics for those sites with non-attainment scores are reported in red (impaired) or green (attainment).

Biotype 1						
Metric	Roaring Fork River 12784	Roaring Fork River 12783 (Rep 1)	Roaring Fork River 12783 (Rep 2)	Roaring Fork River 12783 (WQCD)	Roaring Fork River 12707A	Roaring Fork River 12705
Taxa Richness	28	26	27	21	29	29
EPT	12	12	7	10	14	15
Clinger Taxa	10	7	6	5	13	16
MMI	50.8	39.7	32.8	35.6	76.0	73.2
HBI	3.92	6.74	7.25	5.04	3.00	2.57
Diversity	3.69	3.30	3.32	3.36	3.86	3.93
Metric	Roaring Fork River 12701	Brush Creek 12761C	Capitol Creek 12744	Snowmass Creek 12738	Crystal River 12731A (Rep 1)	Crystal River 12731A (Rep2)
Taxa Richness	24	32	25	32	32	26
EPT	9	12	12	13	12	12
Clinger Taxa	10	13	9	11	13	9
MMI	66.7	59.7	60.6	57.4	65.4	58.2
HBI	3.61	4.23	3.01	2.99	2.81	2.11
Diversity	3.34	3.87	3.45	4.04	4.10	3.71
Metric	Crystal River 12731	Crystal River 12731 (WQCD)	Thompson Creek 12799C	Cattle Creek 12719	Fourmile Creek 12711	Cattle Creek 12725 (WQCD)
Taxa Richness	32	26	30	32	26	27
EPT	15	12	17	5	11	16
Clinger Taxa	12	12	17	8	10	11
MMI	74.8	63.0	82.8	41.2	75.4	82.3
HBI	3.40	4.39	2.13	6.61	4.28	3.36
Diversity	3.91	3.26	2.84	3.39	3.64	3.40

Table 2: Biotype 2 metric results. All sites met the CDPHE requirements for attainment of aquatic life use.

Biotype 2						
Metric	Crystal River 12735	Crystal River 12731B	Coal Creek 12732A	Fourmile Creek 12718A	Crystal River 12732 (WQCD)	West Sopris Creek 12794A (WQCD)
Taxa Richness	25	29	23	33	30	28
EPT	13	17	14	19	16	15
Clinger Taxa	6	13	11	12	12	9
MMI	67.7	86.0	71.4	81.5	83.6	65.2
HBI	2.72	2.36	3.46	3.29	2.85	1.72
Diversity	3.61	3.33	2.65	3.60	3.26	3.58

Biotype 1: MMI Scores (Fall 2011)

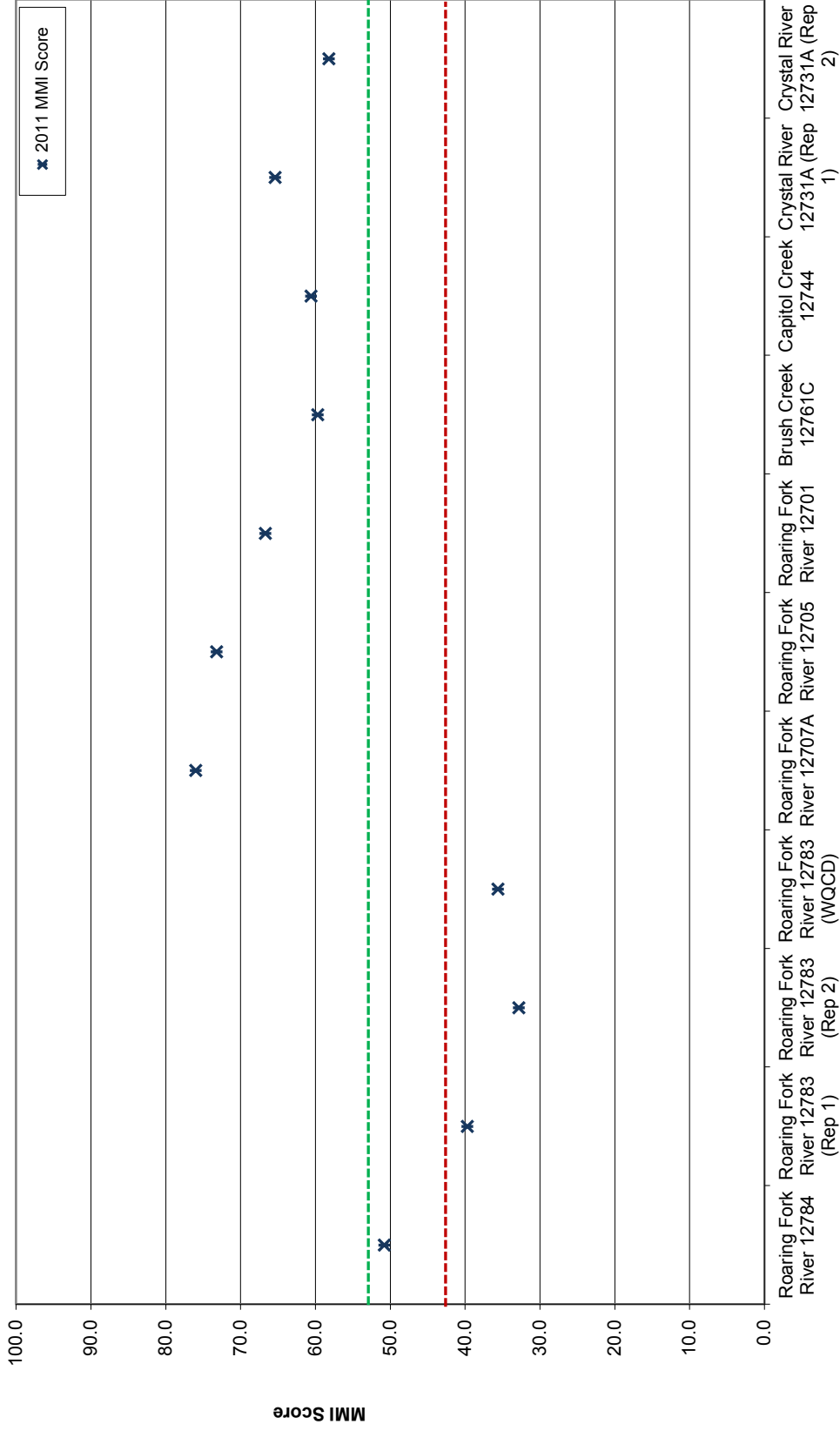


Figure 2: MMI scores for sites in Biotype 1 (additional sites from Biotype 1 are included in Figure 3). The threshold for aquatic life use attainment is represented by the green dashed line, and the threshold for impairment is represented by the red dashed line.

Biotype 1: MMI Scores (Fall 2011)

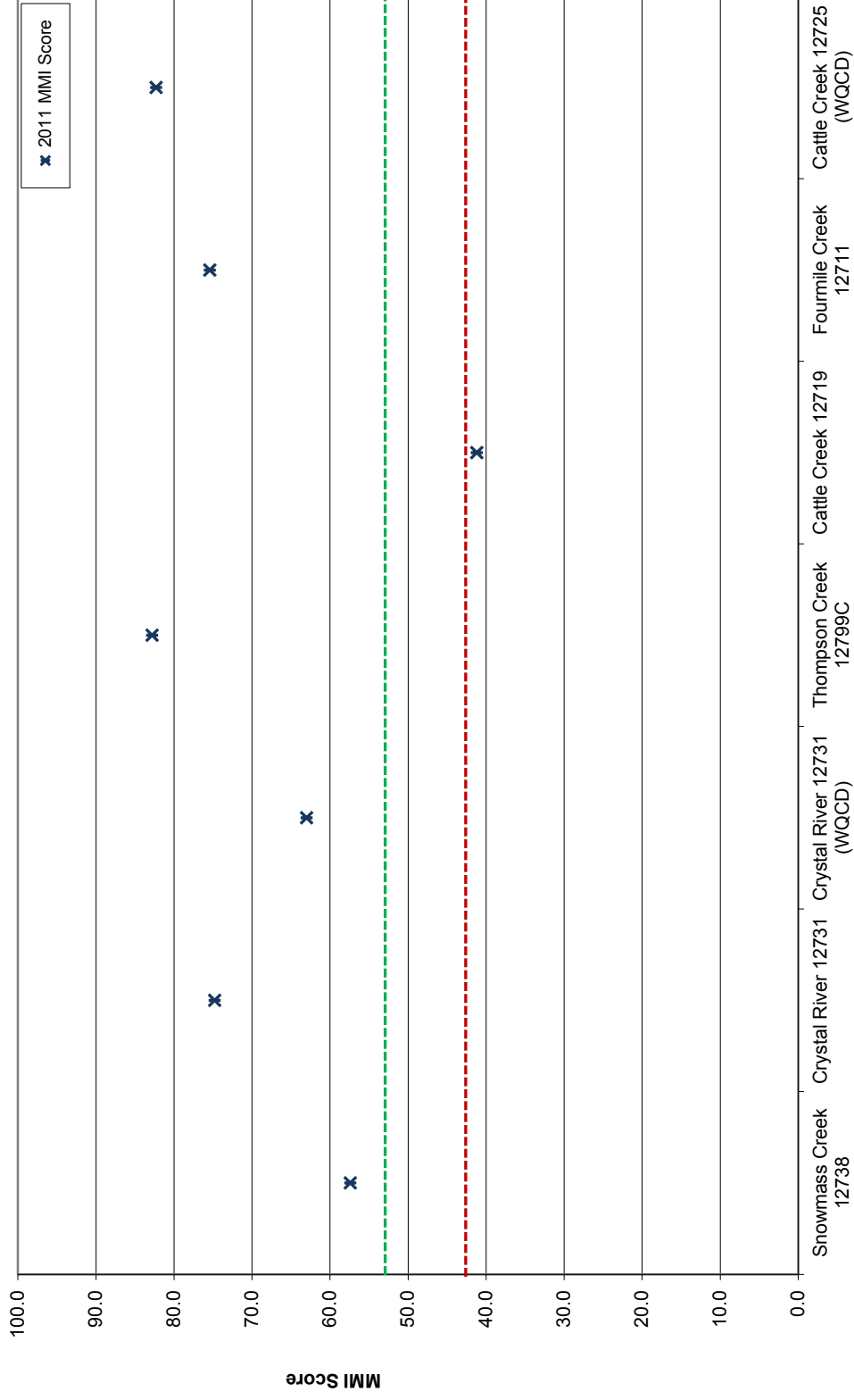


Figure 3: MMI scores for sites in Biotype 1 (additional sites from Biotype 1 are included in Figure 2). The threshold for aquatic life use attainment is represented by the green dashed line, and the threshold for impairment is represented by the red dashed line.

Biotype 2: MMI Scores (Fall 2011)

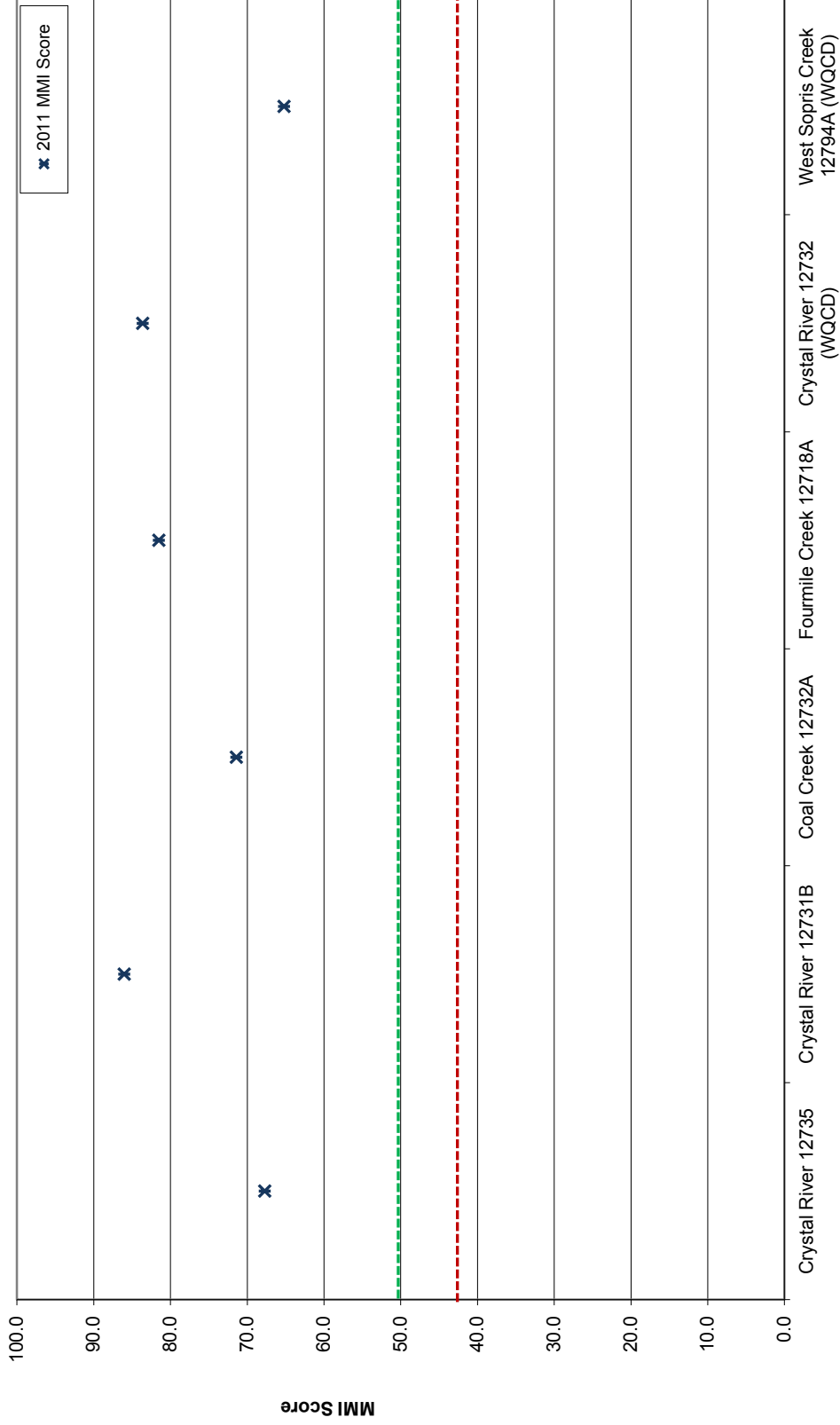


Figure 4: MMI scores for sites in Biotype 2. The threshold for aquatic life use attainment is represented by the green dashed line, and the threshold for impairment is represented by the red dashed line.

Roaring Fork Watershed Macroinvertebrate Attained and Impaired Sites

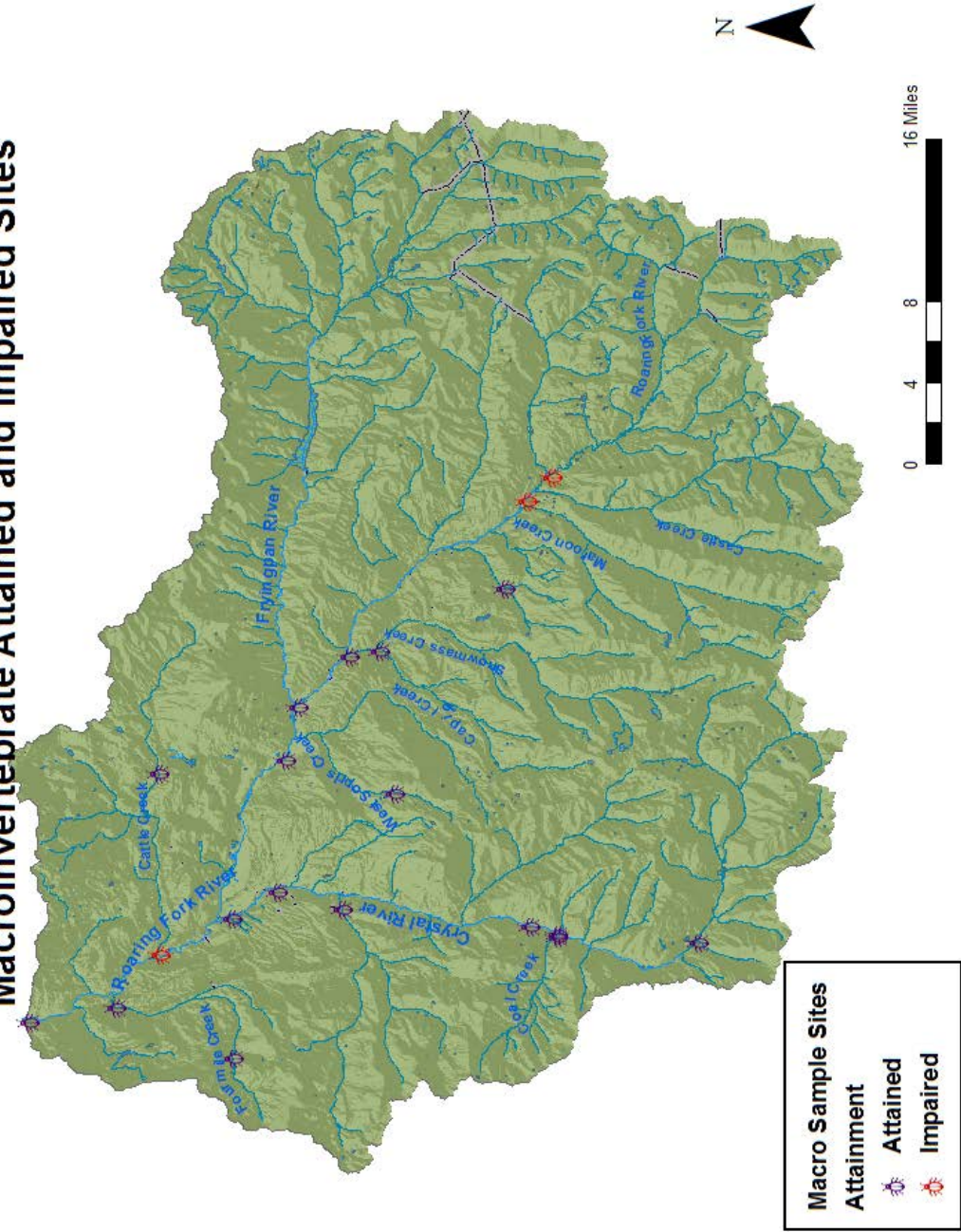


Figure 5. 2011 Macroinvertebrate Study Results.

Upper Roaring Fork River

River Watch Site Name and (Number): Mill Street Bridge (770)

WQCD Site ID: 12784

Coordinates (NAD 83): N 39.194026 W -106.81716

Site Description:

Located on the Roaring Fork River in Aspen just upstream of the Mill Street Bridge, the site is 0.25 mile from downtown Aspen. Roughly 35 percent of Aspen is above this site. This site is above the confluence with most major tributaries in the Aspen area: Hunter, Castle, and Maroon Creeks. The river at the sample location is approximately 25 ft. wide and averages 0.75 ft. deep with primarily riffles and runs. The banks have been stabilized by boulders. Closer to the bridge channelization narrows and deepens the river. Substrate is predominately cobble and the riparian zone extends 6 to 7 ft. from either bank. This stream reach could be influenced by urban impacts as well as upstream diversions, including the Salvation Ditch and some City of Aspen ditches. The Salvation Ditch can divert 59 cfs. Near the headwaters of the Roaring Fork River, the Independence Pass Transmountain Diversion System diverts on average 37 percent of the Upper Roaring Fork River.

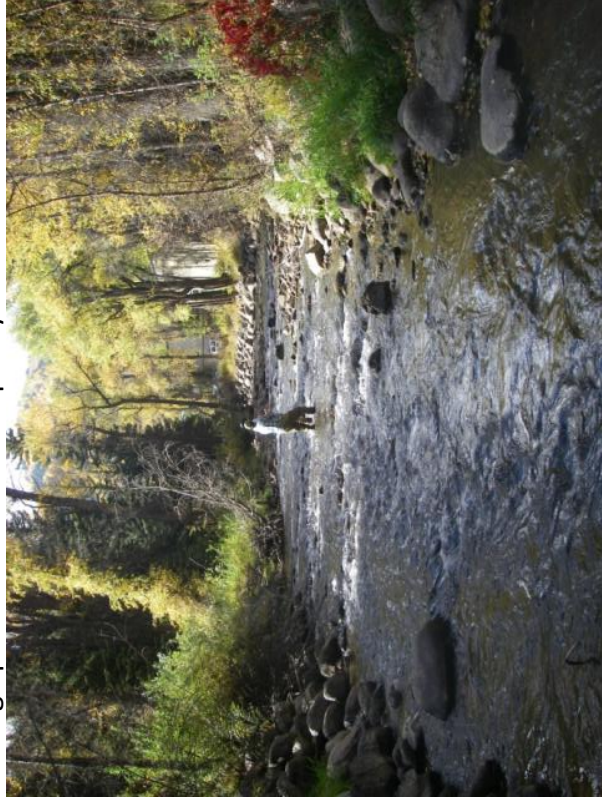
The [2006 Roaring Fork Watershed Water Quality Report](#) placed this reach on the Watch List because of elevated suspended solids levels. Iron exceeded water quality standards once in September 2002 and selenium exceeded once in January and once in July of 2004 ([2008 State of the Roaring Fork Watershed Report](#)).

Benthic Macroinvertebrate Review:

This site's position upstream of major tributaries potentially provides a valuable comparison to determine if Hunter, Castle, or Maroon Creeks (all Roaring Fork River tributaries) influence aquatic macroinvertebrates as a result of their confluence with the Roaring Fork River further downstream. The MMI score produced at this site (51.0) fell within the "gray zone" between the thresholds for attainment and impairment; however, both of the auxiliary metrics (HBI and Diversity) produced values indicating the condition of aquatic life was in attainment at this site. Benthic macroinvertebrate communities appeared to be well-balanced, and the relatively low HBI value (3.92) suggested minimal impact from nutrient enrichment. Alternatively, the relatively low EPT metric value indicated that taxa with sensitivity to general perturbations had been reduced (Table 1). Human-induced impacts on aquatic life are a potential source of stress at this site due to nearby channelization and this site's proximity to downtown Aspen. Additionally, several upstream diversions may reduce water flow through this reach, potentially affecting benthic macroinvertebrate communities.

Upper Roaring Fork River, Mill Street Bridge (770)

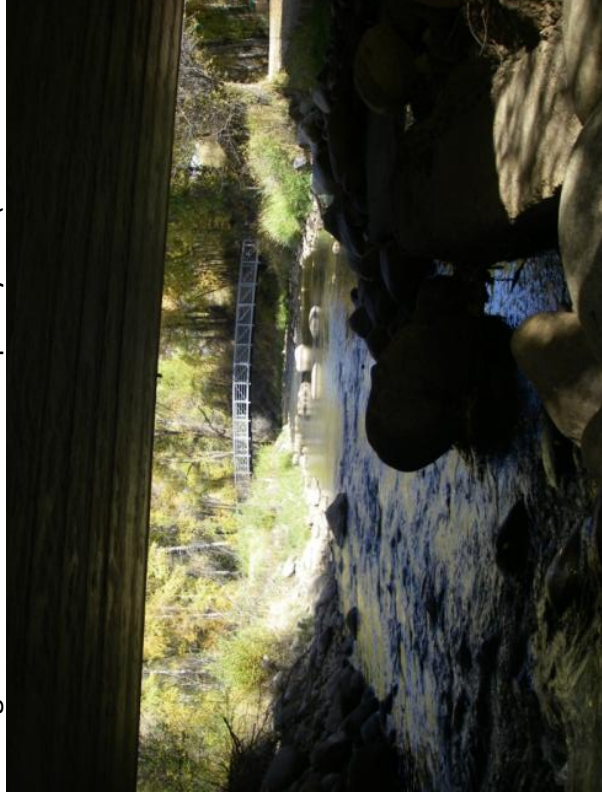
Looking upstream from water quality site to kick location



Standard water quality sample site just below kick location



Looking downstream from water quality site (Under Mill St Bridge)



Roaring Fork River - Slaughterhouse Bridge

River Watch Site Name and (Number): Slaughterhouse Bridge (68)

WQCD Site ID: 12783

Coordinates (NAD 83): N 39.210764 W -106.839472

Site Description:

This site is located on the Roaring Fork River below Aspen and just upstream of the Cemetery Lane Bridge (Slaughterhouse Bridge). It is downstream of the Mill Street Bridge site and below at least 65 percent of Aspen but upstream of the Aspen Wastewater Treatment Facility. The river at the sample location is approximately 63 ft. wide and averages 1 ft. deep with primarily riffles and runs. Substrate is predominately cobble/boulder and the riparian zone extends approximately 7 ft. on the left bank and 15 ft. on the right bank. This site is located in a semi-urban setting with sparse housing on the left bank and forest (except for a bike path) on the right bank. This stream reach could be influenced by urban impacts and is likely affected by upstream diversions. The Salvation Ditch and City of Aspen ditches divert water in the Aspen area. Near the headwaters of the Roaring Fork River, the Independence Pass Transmountain Diversion System diverts on average 37 percent of the Upper Roaring Fork River. Two major tributaries in the Aspen area, Hunter and Castle Creeks, join the Roaring Fork River upstream of this site and Maroon Creek joins below this site.

The [2006 Roaring Fork Watershed Water Quality Report](#), based primarily on River Watch data, placed this reach of the Roaring Fork River on the Watch List due to aluminum levels periodically above chronic standards for aquatic biota. Dissolved oxygen and selenium exceeded water quality standards one or more times. The selenium exceedances occurred during various months from 2001 to 2004, indicating these exceedances are not primarily associated with a seasonal source (e.g. irrigation adjacent to streams or snowmelt) ([2008 State of the Roaring Fork Watershed Report](#)). This section of the Roaring Fork River is on the 2012 State of Colorado 303(D) list for aquatic life.

Benthic Macroinvertebrate Review:

The Slaughterhouse Bridge site location provides an opportunity to assess additional urban runoff from the City of Aspen and potential impacts caused by Hunter and Castle Creeks. Three samples collected were collected by two entities (RFC and WQCD). All three samples produced MMI scores that indicated impaired conditions for benthic macroinvertebrates. A reduction in sensitive taxa and an increase in the proportion of Oligochaeta (worms) were the cause for this decline in metric values. This type of shift in the benthic community typically occurs as a response to stressed conditions. Metrics that detect a variety of general disturbances (EPT and Clinger Taxa) indicated an increase in stress at this site, and the relatively high HBI value suggested possible impacts from nutrient enrichment (Table 1).

Roaring Fork River, Slaughterhouse Bridge (68)

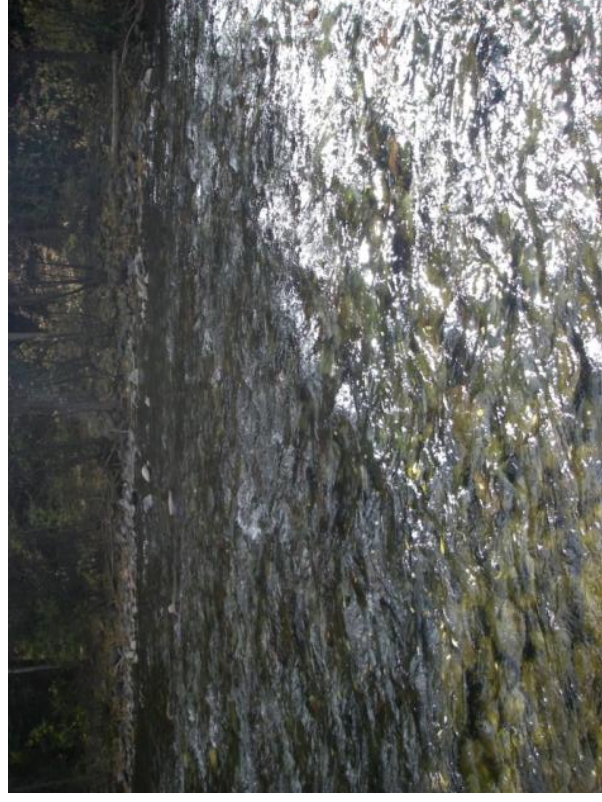
Looking upstream from macro sample site



Looking downstream from macro sample site



Macro sample Site



Kick location



Roaring Fork River 7-11 Bridge

River/Stream: Roaring Fork River

River Watch Site Name and (Number):7-11 Bridge (72)

WQCD Site ID: 12707A

Coordinates (NAD 83): N 39.3659825 W -107.03373

Site Description:

This site is located on the Roaring Fork River in Basalt just downstream of the 7-11 Bridge (now a pedestrian bridge). This site is immediately upstream of the Roaring Fork and Fryingpan River confluence. It is located between Hwy 82 and Two Rivers Road in Basalt with approximately 50 percent of Basalt above this site. The river at the sample location is approximately 70 ft. wide and averages 3 ft. deep with primarily riffles. Substrate is predominately cobble/boulder and the riparian zone extends approximately 50 ft. from either bank. Developed land decreases upstream of the sample location and the riparian area increases. This site is located in an urban setting with some housing on the immediate left bank and businesses on the right bank. This reach of the Roaring Fork River has been highly altered (straightened and channelized) with large berms (rip-rap) protecting businesses and houses near the sample location. Housing impacts extend upstream and the Roaring Fork Club Golf Course is located approximately two miles upstream. Approximately 3.5 miles upstream of this site, Snowmass/Capitol Creeks join the Roaring Fork River as a major tributary.

The [2006 Roaring Fork Watershed Water Quality Report](#), based primarily on River Watch data, placed this reach of the Roaring Fork River on the Healthy Stream List due to increased flow from Snowmass/Capitol Creeks. This site exceeded water quality standards for pH, temperature, and dissolved oxygen one or more times. The three dissolved oxygen exceedances at this site did not reflect the overall condition where the median value was 9.55 mg/L, indicating well-oxygenated conditions. Generally water temperatures were within water quality standards, with only one exceedance in August, 2000. Exceedances of pH were found from 1997 to 2004, mainly during winter and spring, suggesting a seasonal effect on pH ([2008 State of the Roaring Fork Watershed Report](#)).

Benthic Macroinvertebrate Review:

The MMI score (76.0) produced by the 7-11 Bridge site was the highest score produced on the Roaring Fork River and indicated that aquatic conditions supported healthy communities. This may be at least partially due to additional flow provided by tributaries joining the Roaring Fork River upstream. Given the location of this site, near the center of the Town of Basalt, human influences appear to have minimal impacts on aquatic life. The EPT and Clinger Taxa metric values produced at this site indicated that sensitive and specialized taxa had increased compared to upstream sites on the Roaring Fork River (Table 1). The relatively high Diversity value indicated good community balance and the low HBI value suggested minimal impacts from nutrients (Table 1).

Roaring Fork River, 7-11 Bridge (72)

Looking upstream from macro sample site



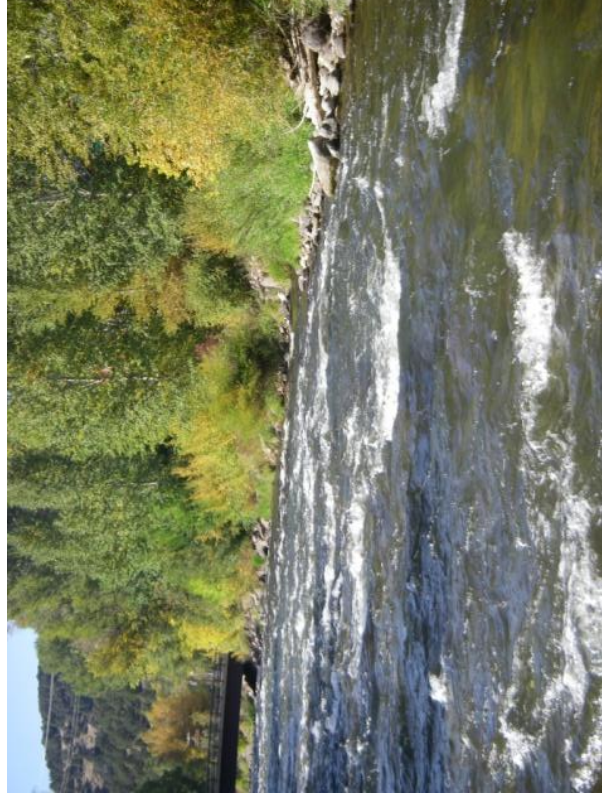
Looking downstream from macro sample site



Macro sample site



Confluence with Fryingspan River immediately downstream



Roaring Fork River – Emma Hook’s Bridge

River/Stream: Roaring Fork River

River Watch Site Name and (Number): Emma Hook’s Bridge (779)

WQCD Site ID: 12705

Coordinates (NAD 83): N 39.373316 W -107.083755

Site Description:

This site is located on the Roaring Fork River in El Jebel just downstream of the Hook’s Lane Bridge near the intersection of Willits and Hook’s Lane. Less than 35 percent of El Jebel is upstream of this site. The river at the sample location is approximately 50 ft. wide and averages 3.5 ft. deep with primarily runs. Substrate is predominately cobble and the riparian zone extends approximately 15 ft. on the right bank and 25 ft. on the left bank. Immediately downstream and upstream of sample site a row of boulders across the river act as drop structures. This site is located in a semi-urban setting with sparse housing on the left bank and a street and businesses on the right bank. The land use is urban with associated impacts. Approximately three miles upstream of this site, the Fryingpan River joins the Roaring Fork River. A number of agricultural diversions occur, including the Harris and Reed Ditch and Robinson Ditch.

The [2006 Roaring Fork Watershed Water Quality Report](#), based primarily on River Watch data, placed this reach of the Roaring Fork River on the Healthy Stream List due to increased volume from the Fryingpan River. Both pH and temperature exceeded water quality standards ([2008 State of the Roaring Fork Watershed Report](#)). The exceedances of pH are probably either related to pH results observed upstream or to the sub-watershed’s geology. Four water temperature exceedances were observed in June and July of 2001 through 2003.

Benthic Macroinvertebrate Review:

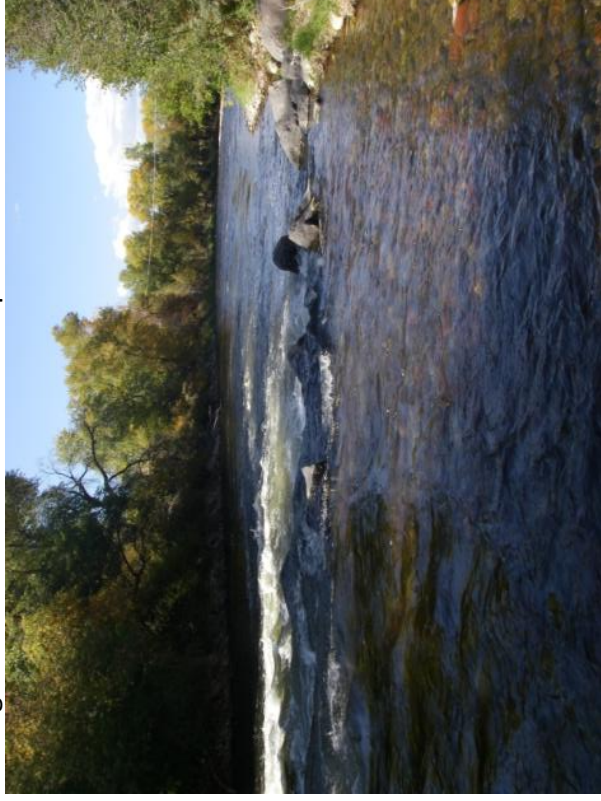
This site provides an opportunity to assess the influence of a large tributary (the Fryingpan River) and changes in land use on the Roaring Fork River. The MMI score (73.2) was above the threshold for attainment and indicated healthy aquatic conditions. Nearby urban areas provided potential sources for perturbations at this site, although the surrounding area is considered semi-urban with about one third of El Jebel located upstream. Metrics designed to measure the number of taxa with specialized habits (Clinger Taxa) and taxa that are generally sensitive to disturbance (EPT taxa) produced values indicating that the benthic communities were relatively healthy. The weakest performing individual metric used for the MMI calculation was the Sensitive Plains Families metric. This metric produced a score of 33.6 (on a scale of 0 to 100); however, this metric often produces negatively biased scores in mountain streams. Overall, the results for this site indicated healthy aquatic conditions in the Roaring Fork River.

Roaring Fork River, Emma Hook's Bridge (779)

Looking upstream from macro sample site



Looking downstream from macro sample site



Macro sample Site



Kick location



Roaring Fork River – 7th Street Bridge

River/Stream: Roaring Fork River

River Watch Site Name and (Number): 7th Street Bridge (45)

WQCD Site ID: 12701

Coordinates (NAD 83): N 39.373316 W -107.083755

Site Description:

This site is located on the Roaring Fork River in Glenwood Springs and 100 yards above the river's confluence with the Colorado River. Located just downstream of the 7th Street Bridge, it is near the intersection of 7th Street and Midland Avenue. Approximately 50 percent of Glenwood Springs is upstream of this site. The river at the sample location is approximately 150 ft. wide and averages 3 ft. deep with primarily runs. Substrate is predominately cobble/gravel and the riparian zone extends approximately 15 ft. on either bank. This site is located in an urban setting with housing on the left bank and a bike path and businesses on the right bank. The surrounding land use is urban with associated impacts and this extends upstream for approximately five miles. The two major tributaries in this lower reach, Fourmile and Cattle Creeks, are two of the more impacted streams in the watershed.

The [2006 Roaring Fork Watershed Water Quality Report](#), based primarily on River Watch data, placed this reach of the Roaring Fork River on the Watch List due to selenium, total suspended solids, and ammonia levels exceeding state standards. Exceedances of pH, total phosphorus, aluminum, iron, and selenium were recorded at this site ([2008 State of the Roaring Fork Watershed Report](#)).

Benthic Macroinvertebrate Review:

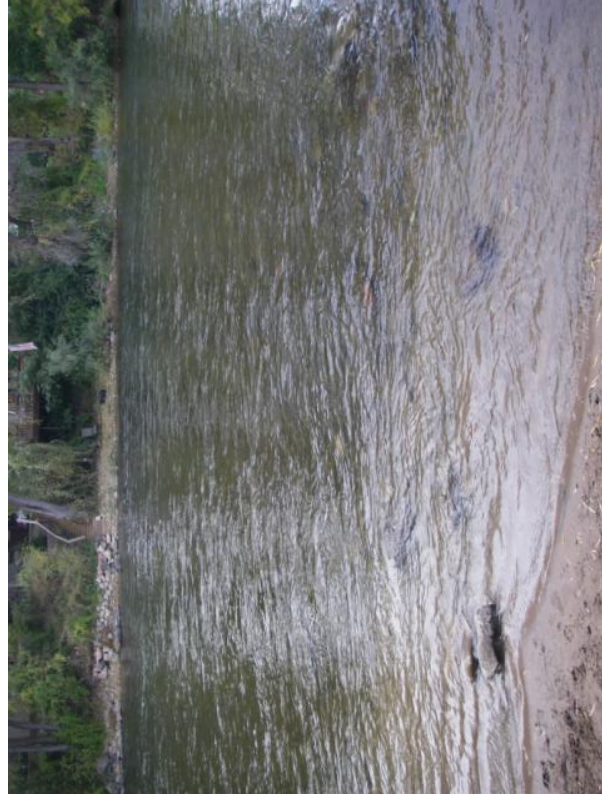
This site is located downstream of tributaries with known impacts (Fourmile and Cattle Creeks), and the results of benthic sampling may partially reflect the effects of these streams on aquatic life in the Roaring Fork River. The surrounding land use is predominately urban, as 50 percent of Glenwood Springs is located upstream of the 7th Street Bridge site, and provides a potential for a variety of anthropogenic effects on aquatic life. The MMI score produced at this site (66.7) was above the threshold for healthy aquatic life in streams; however, this score had declined compared to upstream sites. The EPT and Clinger Taxa metric values produced at this site indicated that relatively healthy benthic macroinvertebrate communities were present, although there was some decline in the number of sensitive and specialized taxa compared to the upstream sites (Table 1).

Roaring Fork River, 7th Street Bridge (45)

Looking upstream from macro sample site



Macro sample site



Looking downstream from macro sample site



Kick location



Brush Creek

River/Stream: Brush Creek

River Watch Site Name and (Number): Above Roundabout (887)

WQCD Site ID: 12761C

Coordinates (NAD 83): N 39.2247 W -106.921

Site Description:

This site is located on Brush Creek below the Town of Snowmass Village and near the Brush Creek Road/Highline Road Intersection (Roundabout). This site is downstream of most of Snowmass Village and at the end of the Snowmass Club Golf Course. Approximately 0.25 mile upstream of this site is the discharge from the Snowmass Village Wastewater Treatment Plant. It is also downstream of the confluence with the East Fork of Brush Creek and roughly five miles upstream of Brush Creek's confluence with the Roaring Fork River. The creek at the sample location is approximately 11 ft. wide and averages 0.5 ft. deep with primarily riffles and runs. Substrate is predominately cobble and the riparian zone extends approximately 6 ft. on the left bank and 15 ft. on the right bank. Beyond the immediate riparian zone, the surrounding area is primarily grasses/golf course.

The [2006 Roaring Fork Watershed Water Quality Report](#), based primarily on River Watch data, placed this stream on the Impacted List due to periodic pH standard exceedances, high phosphorous levels, and a Family Biotic Index indicating some organic pollution is probable. These results led to a follow-up targeted study, the [2007 Brush Creek Water Quality Study](#). This study found that: 1) although all pH levels did not exceed state standards in this study, there is supposition that past pH elevation are coincidental with low flows; 2) a marked spike in nitrate levels exists between the Snowmass Chapel and above the roundabout; and 3) although there were no state standards for phosphate, Brush Creek levels are consistently high. Brush Creek is currently on the State of Colorado 2012 303(D) list for aquatic life.

Benthic Macroinvertebrate Review:

Anthropogenic effects on aquatic life are likely at this site because it is located downstream from Snowmass Village and Snowmass Club Golf Course. There is also potential for impacts from elevated levels of nutrients because Brush Creek flows through much of the golf course and receives effluent from the Snowmass Village WWTP. Macroinvertebrate data from this site indicated a relatively high proportion of non-insect taxa which caused some decline in the MMI value. This is an expected response to stress in many Colorado streams. The MMI value produced at this site (59.7) was near the attainment threshold, but indicated that conditions were adequate for supporting aquatic life. Other metrics, including the EPT and Clinger Taxa metrics, suggested that aquatic conditions were less than optimal but not impaired at this site (Table 1). The HBI value for this site (4.23) appeared to be slightly elevated by the presence of nutrients, but it was not at a level indicating impaired conditions.

Brush Creek, Above Roundabout (887)

Looking upstream from water quality site to kick location



Looking downstream from water quality site



Standard water quality sample site just below kick location



Kick location



Capitol Creek

River/Stream: Capitol Creek

River Watch Site Name and (Number): Capitol Creek (773)

WQCD Site ID: 12744

Coordinates (NAD 83): N 39.310211 W -106.980968

Site Description:

This site is located on Capitol Creek approximately 100 ft. above its confluence with Snowmass Creek and just off Snowmass Creek Road (CR 11). It is located approximately 1.5 miles upstream of Hwy 82 and the Snowmass Creek Confluence with the Roaring Fork River. This is within the area generally known as Old Snowmass. Capitol Creek does not have any urban areas. The lower 7 to 10 miles of the creek are primarily sparse housing and agricultural fields. Upstream of that is primarily National Forest and some wilderness areas. The creek at the sample location is 16 ft. wide and averages 1 ft. deep with primarily riffles. Substrate is predominately cobble and boulder, and the riparian zone extends approximately 15 ft. from either bank. Beyond the immediate riparian zone, the surrounding area is a combination of sparse housing, agricultural fields, and some natural areas.

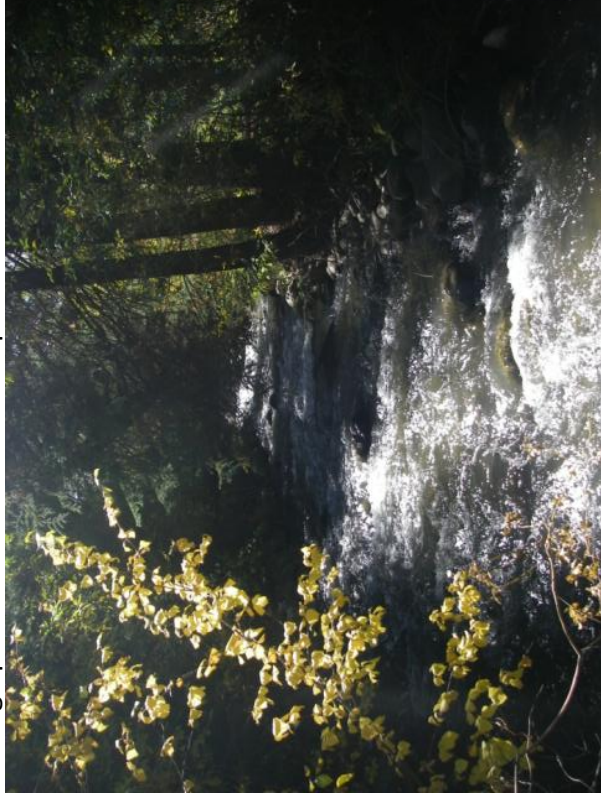
The [2006 Roaring Fork Watershed Water Quality Report](#), based primarily on River Watch data, placed this stream on the Watch List due to selenium and sulfate levels exceeding state standards on occasion. Exceedances of temperature, sulfate, selenium, aluminum, and iron were found at this site ([2008 State of the Roaring Fork Watershed Report](#)). The one exceedances of temperature occurred in July, 2002, a low flow year. The selenium exceedances occurred from March through October and are most likely related to irrigation of land underlain by Mancos Shale. Capitol Creek is on the 2012 State of Colorado 303(D) list for selenium levels.

Benthic Macroinvertebrate Review:

Minimal human impacts on benthic macroinvertebrate communities are expected at this site because upstream reaches are located in National Forest and Wilderness areas. The MMI score produced at this site (60.6) indicated that conditions to support aquatic life were met, as the score was above the threshold (52.2) for attainment. Relatively low EPT and Clinger Taxa metric values indicated that some stress to aquatic life may have been occurring at this location. The surrounding land use near Capitol Creek includes limited urban development, agricultural fields, and natural areas.

Capitol Creek, Capitol Creek (773)

Looking upstream from macro sample site



Looking downstream from macro sample site



Macro sample site



Kick location



Snowmass Creek

River/Stream: Snowmass Creek

River Watch Site Name and (Number): Snowmass Creek (774)

WQCD Site ID: 12738

Coordinates (NAD 83): N 39.330866 W -106.986115

Site Description:

This site is located on Snowmass Creek approximately 200 yards above its confluence with the Roaring Fork River and near the intersection of Snowmass Creek Road (CR 11) and Hwy 82. This is within the area generally known as Old Snowmass. Snowmass Creek does not have any urban areas along its course. The lower 10 to 12 miles of the creek are primarily sparse housing and agricultural fields. Upstream of that is predominantly National Forest land and some wilderness areas. The creek at the sample location is approximately 30 ft. wide and averages 1.5 ft. deep with primarily riffles. Substrate is predominately boulders, and the riparian zone extends approximately 50 ft. from the left bank and 100 ft. from the right bank. Beyond the riparian zone, is a combination of sparse housing/business on the right bank and natural areas on the left bank. Immediately downstream of the site is a water diversion return flow.

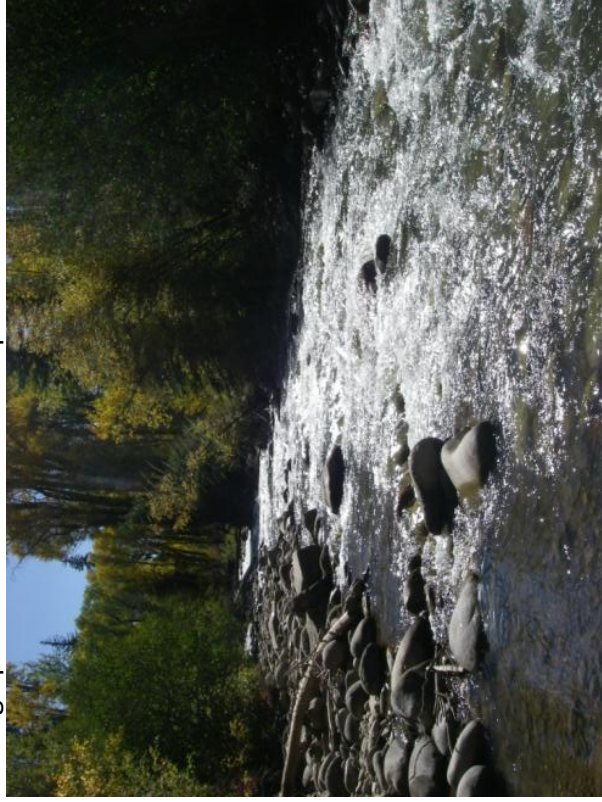
The [2006 Roaring Fork Watershed Water Quality Report](#), based primarily on River Watch data, placed this stream on the Watch List due to selenium and iron levels exceeding state standards on occasion. Exceedances of temperature, sulfate, aluminum, and iron were found at this site ([2008 State of the Roaring Fork Watershed Report](#)). The one exceedance of temperature occurred in July, 2002, a low flow year.

Benthic Macroinvertebrate Review:

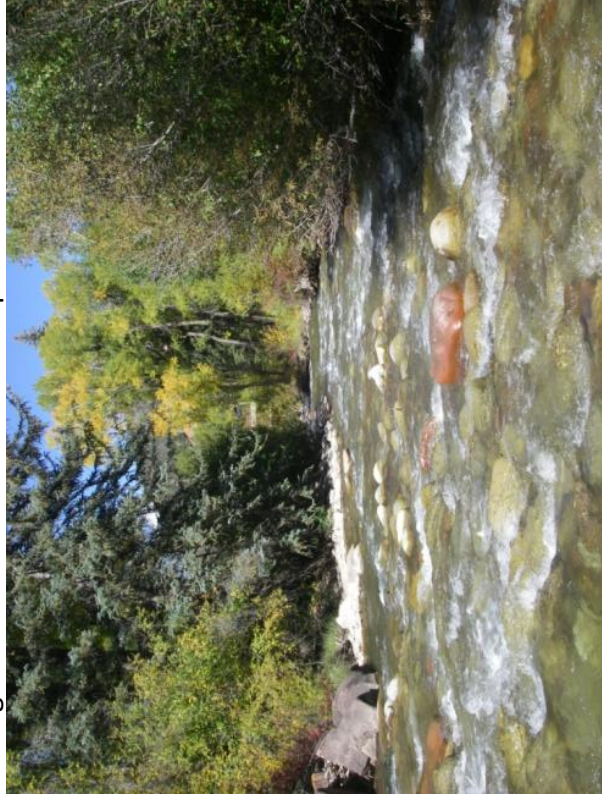
Limited anthropogenic influences are expected to be present at this site, as the surrounding land use is predominately agricultural, with sparse housing. The area upstream of this site is National Forest/Wilderness with no urban influences, so minimal human-generated disturbances were expected. The MMI score produced at this site (57.4) was near the threshold for aquatic life attainment, but indicated that the site supported healthy benthic macroinvertebrate communities. The EPT metric and Clinger Taxa metric values indicated that there were an adequate number of sensitive taxa and taxa with specialized habits. The relatively low MMI score resulted from a negative bias from the Sensitive Plains Families metric. This was the weakest performing individual metric used for calculation of the MMI. The Sensitive Plains Families metric produced a score of 12.4 (on a scale of 0 to 100) while other components of the MMI produced much better values. Because the Sensitive Plains Families metric was developed for "plains streams" it is likely that it misrepresents conditions in some mountain streams.

Snowmass Creek, Snowmass Creek (774)

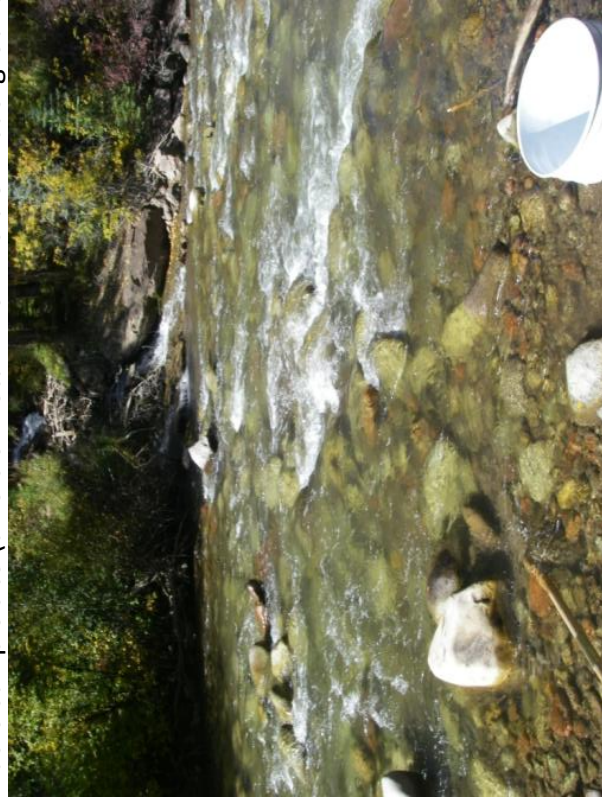
Looking upstream from macro sample site



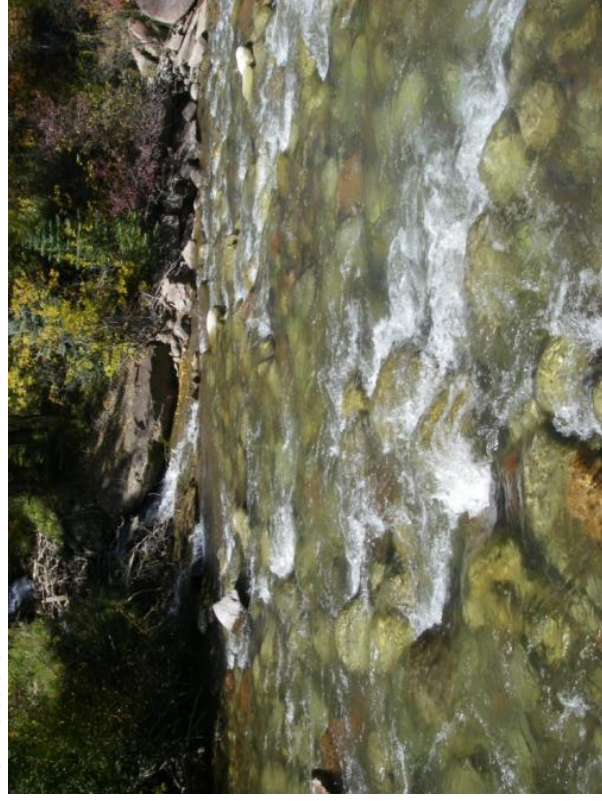
Looking downstream from macro sample site



Macro sample site (diversion return flow visible in background)



Kick location



West Sopris Creek

River/Stream: West Sopris Creek

River Watch Site Name and (Number): Above Diversion for Dinkle Lake

WQCD Site ID: 12794A

Coordinates (NAD 83): N 39.2981 W -107.1119

Site Description:

No information on this site was provided. West Sopris Creek is currently listed on the State of Colorado 303(D) list for aquatic life.

Benthic Macroinvertebrate Review:

The only site located on West Sopris Creek was in Biotype 2 and the macroinvertebrate sample was collected by the WQCD. The MMI score produced at this site (65.2) was above the threshold for aquatic life use attainment indicating relatively healthy aquatic conditions. Taxa with known sensitivities to disturbance (measured by the EPT metric) were present in relatively high numbers at this site, while clinger taxa appeared to be mildly affected by some form of disturbance. Other metrics demonstrated relatively healthy aquatic conditions with no influence from nutrients.

Site Photos:

No site photos were provided for this site.

Crystal River – Genter Mine Bridge

River/Stream: Crystal River

River Watch Site Name and (Number): Genter Mine Bridge (735)

WQCD Site ID: 12735

Coordinates (NAD 83): N 39.085384 W -107.242264

Site Description:

This site is located on the Crystal River approximately four miles downstream from the small town of Marble and immediately downstream of the County Road 3 Bridge (Genter Mine Bridge). The small town of Marble and a working marble mine are the primary upstream potential impacts. Further upstream is National Forest land and some wilderness areas. The river at the sample location is approximately 55 ft. wide and averages 1.5 ft. deep with primarily riffles and pools. Substrate is predominately cobble/boulder and the riparian zone extends approximately 8 ft. on the right bank and 30 ft. on the left bank. Except for a few houses in the immediate area, the surrounding land is primarily natural areas (forest/fields).

The [2006 Roaring Fork Watershed Water Quality Report](#), placed this reach on the Healthy Stream List due to its headwaters nature. No samples exceeded water quality standards at this site ([2008 State of the Roaring Fork Watershed Report](#)).

Benthic Macroinvertebrate Review:

The Genter Mine Bridge site is contained within Biotpe 2 and produced an MMI score (67.7) indicating that aquatic life use at this site was in attainment. A moderate number of specialized taxa (measured by the Clinger Taxa metric) were present, and the EPT metric value indicated that a good number of sensitive taxa were also present at this site. These metrics did not detect excessive stress to aquatic life but they also did not represent optimum aquatic conditions. Some metrics may have been adversely affected by sampling difficulties associated with the large substrate size. The relatively low HBI value (2.72) produced at this site indicated that nutrient enrichment was probably not a source of disturbance. National Forest and Wilderness areas are present upstream and the areas surrounding this site contain only sparse housing, minimizing any potential for human-generated perturbations on benthic communities.

Crystal River, Genter Mine Bridge (735)

Looking upstream from water quality site



Looking downstream from water quality site



Macro sample site



Kick location



Crystal River – At Redstone

River/Stream: Crystal River

River Watch Site Name and (Number): At Redstone

WQCD Site ID: 12732

Coordinates (NAD 83): N 39.18266667 W -107.2378333

Site Description:

No information on this site was provided.

Benthic Macroinvertebrate Review:

This site is located in Biotype 2 and the macroinvertebrate sample was collected by the WQCD. Optimum conditions to support healthy aquatic communities were reflected by the relatively high MMI score (83.6) produced at this site. The Clinger Taxa and EPT metrics also demonstrated that healthy aquatic conditions were available to support sensitive and specialized taxa at this site on Crystal River.

Site Photos:

No site photos were provided for this site.

Crystal River – Below Redstone

River/Stream: Crystal River

River Watch Site Name and (Number): Below Redstone (736)

WQCD Site ID: 12731B

Coordinates (NAD 83): N 39.20175 W -107.23108

Site Description:

This site is located on the Crystal River below Redstone and just upstream of the North Redstone Blvd Bridge. It is between Hwy 133 and Redstone Boulevard and 1.5 miles below the confluence with Coal Creek, a major tributary to the Crystal River. This site is downstream of the Redstone wastewater treatment plant. The reach through Redstone has been channelized and straightened. Coal Creek, an upstream tributary, introduces a substantial amount of sediment to the Crystal River. The river at the sample location is approximately 30 ft. wide and averages 2 ft. deep with primarily riffles and runs. Substrate is predominately cobble and the riparian zone extends approximately 100 ft. on the left bank and 15 ft. on the right bank. No major housing exists in the immediate vicinity.

The [2006 Roaring Fork Watershed Water Quality Report](#), based primarily on River Watch data, placed this reach of the Crystal River on the Watch List due to pH spikes during drought years and one occurrence of high sulfate levels. Exceedances of dissolved oxygen, sulfate, total phosphorus, aluminum, copper, iron, and lead have occurred at this site ([2008 State of the Roaring Fork Watershed Report](#)). The major source of iron is Coal Creek, where impacts from the closed Mid-Continent Resource Coal Mine are a point source of iron and sediment.

Benthic Macroinvertebrate Review:

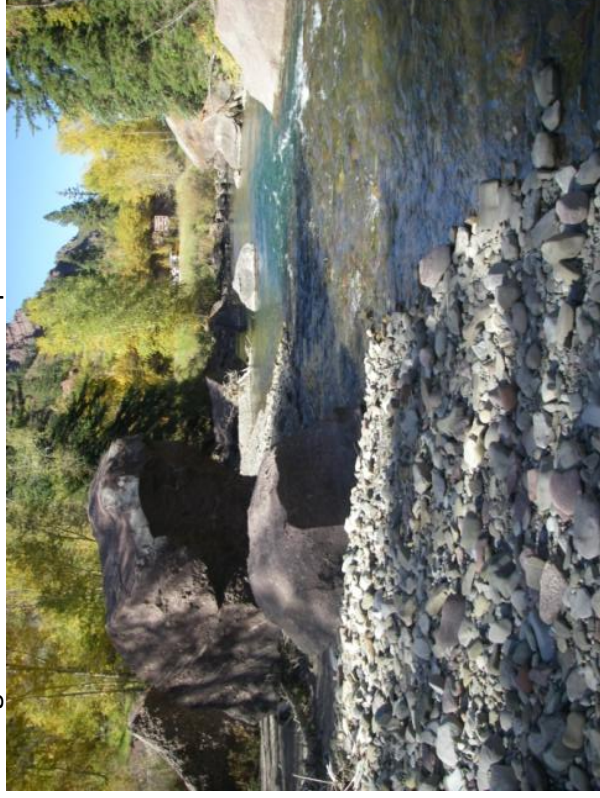
The Crystal River below Redstone site (site 12731B) is in Biotype 2 and produced the highest MMI score (86.0) among all sites in the study area. This score was well above the threshold for aquatic life use attainment and indicated healthy benthic macroinvertebrate communities and aquatic conditions. Additional metric values (EPT and Clinger Taxa) produced from this site confirmed that conditions to support healthy benthic macroinvertebrate communities were present (Table 1). Historically, Coal Creek introduces a significant amount of sediment downstream from its confluence with the Crystal River. Impacts from sedimentation would generally be reflected in a low Clinger Taxa metric value; however, the number of clinger taxa at this site suggested optimum conditions during the fall of 2011.

Crystal River, Below Redstone (736)

Looking upstream from macro sample site



Looking downstream from macro sample site



Macro sample site



Crystal River – Crystal Fish Hatchery

River/Stream: Crystal River

River Watch Site Name and (Number): Crystal Fish Hatchery (75)

WQCD Site ID: 12731A

Coordinates (NAD 83): N 39.3773646 W -107.20467

Site Description:

This site is located on the Crystal River above Carbondale and downstream of the County Road 118 Bridge (Fish Hatchery Bridge). This site is upstream of Carbondale and near the Hwy 133 and CR 118 intersection. It is downstream of a substantial amount of agricultural land. Several large agricultural and municipal diversions influence the lower Crystal, including the Sweet Jessup, East Mesa, Lowline, Bowles and Holland, Rockford, and Carbondale Ditches. The river at the sample location is approximately 60 ft. wide and averages 1 ft. deep with primarily runs. Substrate is predominately cobble/boulder and the riparian zone extends approximately 5 ft. on the left bank and 10 ft. on the right bank. In the immediate area, housing/buildings are on the right bank and the Colorado Parks and Wildlife Carbondale Fish Hatchery is on the left bank. Beyond the immediate area the surrounding land use is primarily agricultural.

The [2006 Roaring Fork Watershed Water Quality Report](#), based primarily on River Watch data, placed the entire lower reach of the Crystal River on the Impacted List due to both quality and quantity concerns. This entire reach was on a state monitoring and evaluation list for sediment. This specific site has exceeded state standards for both iron and sulfates. In addition this site has exhibited late summer flows which are significantly lower than natural conditions, primarily due to the above mentioned diversions. These low flows often did not meet the Colorado Water Conservation Board's in-stream flow amounts. Exceedances of total phosphorus, aluminum, iron, and selenium were found at this site ([2008 State of the Roaring Fork Watershed Report](#)). The highest total recoverable iron concentration in the watershed was observed at this site (15,192 µg/L).

Benthic Macroinvertebrate Review:

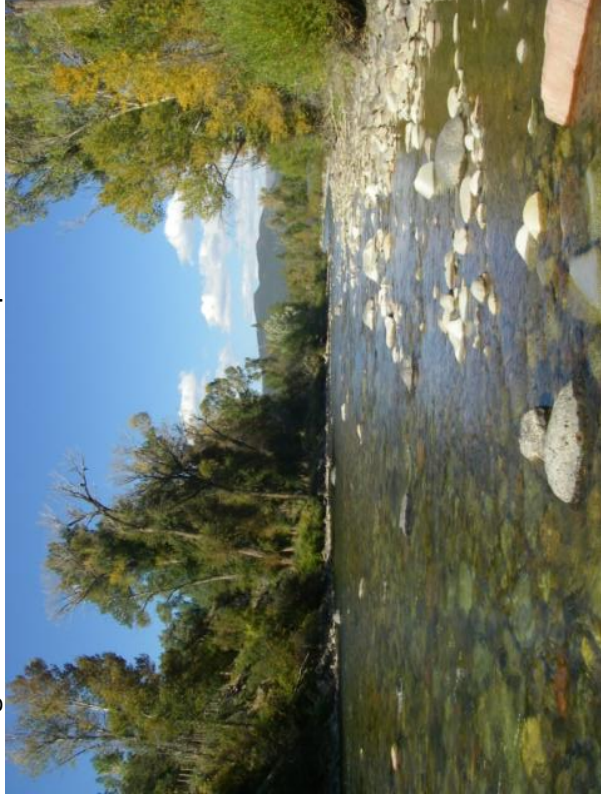
Two replicate samples were collected at the Crystal River Fish Hatchery site (site 12731A) by RFC staff and macroinvertebrate data from these samples produced relatively similar results. Both MMI scores (65.4 and 58.2) were above the threshold for aquatic life use attainment, indicating that healthy aquatic conditions were present at this site (Table 1). The EPT value (12) produced from both samples for this site indicated there was little evidence of stress influencing taxa with known sensitivities to disturbance. Taxa with specialized habits (Clinger Taxa) were also present in relatively high numbers suggesting minimal impact to benthic macroinvertebrates at this site. The HBI metric values indicated that impacts from nutrient enrichment were essentially undetectable.

Crystal River, Crystal Fish Hatchery (75)

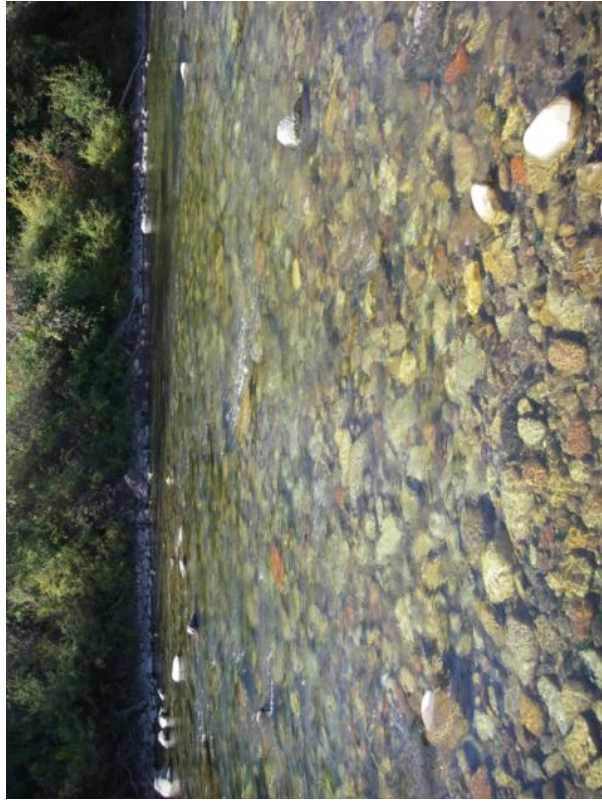
Looking upstream from macro sample site



Looking downstream from macro sample site



Macro sample site



Kick location



Crystal River – CRMS Bridge

River/Stream: Crystal River

River Watch Site Name and (Number): CRMS Bridge (78)

WQCD Site ID: 12731

Coordinates (NAD 83): N 39.40831 W -107.23022

Site Description:

This site is located on the Crystal River in Carbondale just upstream of the Thompson Creek Road (County Road 108) Bridge (CRMS Bridge). This site is downstream of 75 percent of Carbondale and approx. 0.8 miles upstream of the Crystal River's confluence with the Roaring Fork River. The River Valley Ranch Golf Course is adjacent to the river along this two mile reach. The river at the sample location is approximately 65 ft. wide and averages 1.5 ft. deep with primarily runs. Substrate is predominately cobble/boulder and the riparian zone extends approximately 20 ft. on the left bank and 10 ft. on the right bank. In the immediate area Colorado Rocky Mountain School buildings are on the right bank and one house is on the left bank. Beyond the immediate area the surrounding land use is primarily agricultural with some natural areas.

The [2006 Roaring Fork Watershed Water Quality Report](#), based primarily on River Watch data, placed the entire lower reach of the Crystal River on the Impacted List due to both quality and quantity concerns. This particular site has exceeded state standards for aluminum in the spring. Macro data collected in 2001 near this site received a Family Biotic Index score indicating some organic pollution likely. Exceedances of temperature, aluminum, and iron were found at this site ([2008 State of the Roaring Fork Watershed Report](#)).

Benthic Macroinvertebrate Review:

Approximately 75 percent of Carbondale's development is located upstream of the CRMS Bridge site on the Crystal River. In addition, the River Valley Ranch Golf Course provides potential for human-generated impacts on aquatic communities at this site. This site is located in Biotype 1 and two samples were collected (one by the RFC and one by the WQCD) during the fall of 2011. Both MMI scores (74.8 and 63.0) produced at this site were above the threshold for attainment and appeared to reflect healthy macroinvertebrate communities (Table 1). Additional metric values produced at this site (EPT and Clinger Taxa) were indicative of relatively healthy aquatic conditions with minimal disturbances to aquatic life.

Crystal River, CRMS Bridge (78)

Looking upstream from macro sample site



Looking downstream from macro sample site



Macro sample site



Kick location



Coal Creek

River/Stream: Coal Creek

River Watch Site Name and (Number): Redstone Park @ Confluence (782)

WQCD Site ID: 12732A

Coordinates (NAD 83): N 39.18263 W -107.24047

Site Description:

This site is located on Coal Creek in the small town of Redstone just upstream of its confluence with the Crystal River. It is immediately downstream of the Hwy 133 Bridge over Coal Creek. Although located in the town of Redstone, this site is largely unaffected by it. This site is downstream of one mile of agricultural land and sparse housing. Beyond that is primarily National Forest land. However, there was substantial historical coal mining in upper Coal Basin. The mining areas have been “reclaimed” but impacts continue, particularly with regards to sediment. Additionally, the natural areas of upper Coal Creek are prone to erosion due to the large steep outcroppings of Mancos Shale. The creek at the sample location is approximately 17 ft. wide and averages 0.5 ft. deep with primarily riffles and runs. The estimated bank full width is wide (54 ft.) and the channel location changes drastically on a yearly basis. Substrate is predominately cobble and the riparian zone extends approximately 40 ft. on the left bank and 5 ft. on the right bank. Beyond the riparian zone the land use is mixed, with a gravel parking lot on the right bank, a natural area on the left bank, and Hwy 133 immediately upstream. A pebble count was taken during sampling.

Based primarily on River Watch data, the [2006 Roaring Fork Watershed Water Quality Report](#) placed this creek on the Watch List due to its placement on the CDPHE watch list for suspended solids (sediment). Exceedances of pH, total phosphorus, aluminum, and iron have been found at this site ([2008 State of the Roaring Fork Watershed Report](#)). Total suspended solid concentrations ranged from < 10 mg/L to 1260 mg/L. On the Crystal River above the confluence with Coal Creek, concentrations ranged from < 10 mg/L to 44 mg/L, while below Coal Creek concentrations ranged from 1.1 mg/L to 215 mg/L.

Benthic Macroinvertebrate Review:

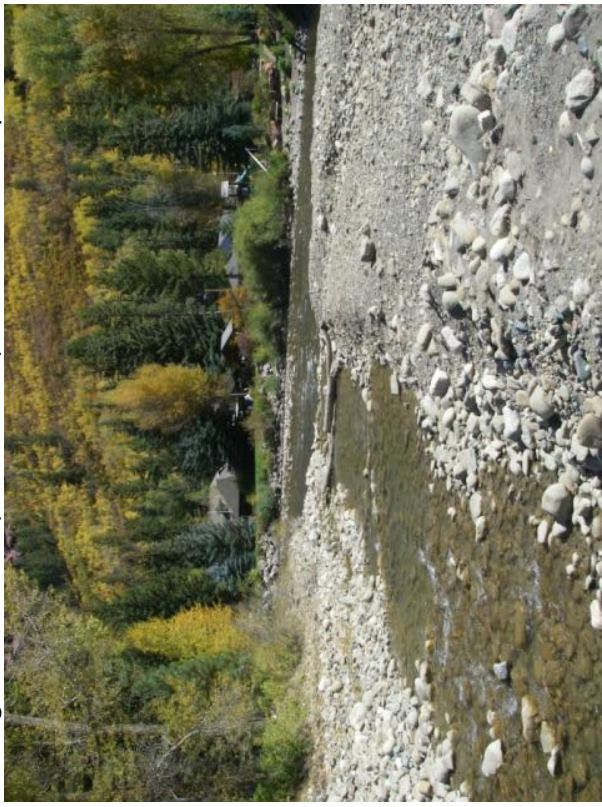
This site was located in Biotype 2 and the MMI score (71.4) was above the threshold for attainment, indicating a healthy macroinvertebrate community in the fall of 2011. Additional metrics (EPT and Clinger Taxa) produced at this site indicated that both specialized taxa and sensitive taxa were present in relatively high numbers, reflecting a well-balanced and healthy aquatic community (Table 2). Minimal urban impacts are expected at this site, as surrounding land use includes a mixture of National Forest, sparse housing, and agricultural fields; however, there is still potential for some impacts associated with sedimentation and historical coal mining activities located further upstream. Future monitoring at this site would be useful for determining the range of impacts from these potential stressors.

Coal Creek, Redstone Park @ Confluence (782)

Looking upstream from macro sample site



Looking downstream (stream view) from macro sample site



Macro sample site



Kick location



Thompson Creek

River/Stream: Thompson Creek

River Watch Site Name and (Number): Above Diversion (7775)

WQCD Site ID: 12799C

Coordinates (NAD 83): N 39.33178333 W -107.2190833

Site Description:

This site is located on Thompson Creek, a major tributary to the Crystal River about five miles upstream of Carbondale. This site is 0.5 mile upstream of the Hwy 133 Bridge over Thompson Creek and 0.75 mile upstream of the Thompson Creek confluence with the Crystal River. It is located immediately upstream of a large diversion which sweeps the creek, leaving the lower section completely dewatered at certain times of the year (Aug -Oct). This site is between agricultural land (downstream) and upstream National Forest and BLM land. Mixed resource extraction activities exist much higher in the Thompson Creek Watershed, including former natural gas extraction, current natural gas underground storage, historical coal mining which has been “reclaimed,” and ongoing logging. In addition, much of the Thompson Creek Watershed has been leased for future natural gas development although no drilling has occurred yet. The creek at the sample location is approximately 20 ft. wide and averages 1 ft. deep with primarily riffles and runs. Substrate is predominately cobble and the riparian zone extends approximately 30 ft. from either bank. Beyond the riparian zone the immediate land use is primarily agricultural.

Based on the potential for natural gas development, RFC partnered with Thompson Divide Coalition to conduct the [2009-2011 Thompson Divide Baseline Water Quality Study](#). This study included macroinvertebrate sampling and was conducted at numerous locations in the upper Thompson Creek Watershed well upstream of this site. Results found these waters to be healthy, uncontaminated, and supporting significant populations of benthic aquatic organisms. Thompson Creek is on the 2012 State of Colorado 303(D) list for iron.

Benthic Macroinvertebrate Review:

The assortment of land use operations occurring in the upper portions of the Thompson Creek watershed provides numerous potential sources of stress to aquatic life at this site. Despite these potential perturbations, the MMI score produced at this site (82.8) was the highest among sites in Biotype 1 during the fall of 2011. All other individual metrics were in agreement with the MMI score, producing values that indicated a well-balanced and healthy aquatic community (Table 1). Aquatic communities at the Thompson Creek site were defined by high numbers of sensitive and specialized taxa with low numbers of nutrient-tolerant taxa. With the variety of current and future resource extraction activities occurring upstream, continued monitoring is recommended at this site to assist in the protection of these healthy aquatic conditions.

Thompson Creek, Above Diversion (7775)

Looking upstream from macro sample site



Looking downstream from sample site (water being diverted)



Macro sample site



Kick location



Thompson Creek dewatered just below diversion and sample site



Cattle Creek – Blue Creek Road Bridge

River/Stream: Cattle Creek

River Watch Site Name and (Number): Blue Creek Road Bridge

WQCD Site ID: 12725

Coordinates (NAD 83): N 39.4606 W -107.098

Site Description:

No information on this site was provided.

Benthic Macroinvertebrate Review:

This site was located in Biotype 1 and the macroinvertebrate sample from the fall of 2011 was collected by the WQCD. The MMI score produced at this site (82.3) was one of the highest MMI scores in the study area and was well above the threshold for aquatic life use attainment. The measure of the number of sensitive taxa provided by the EPT metric (16) was also one of the highest in the study area. All other individual metrics from this site were in agreement that aquatic conditions supported healthy benthic macroinvertebrate communities (Table1).

Site Photos:

No site photos were provided for this site.

Cattle Creek – Hwy 82 Culvert

River/Stream: Cattle Creek

River Watch Site Name and (Number): Hwy 82 Culvert (7888)

WQCD Site ID: 12719

Coordinates (NAD 83): N 39.4572 W -107.265

Site Description:

This site is located on Cattle Creek, a major tributary to the lower Roaring Fork River between Glenwood Springs and Carbondale. It is downstream of the Hwy 82 culvert and upstream of the Rio Grande bike path bridge over the creek. Located on a RFC conservation easement, it is approximately one mile upstream of the Cattle Creek confluence with the Roaring Fork River. The first two upstream miles contain numerous businesses as well as some industrial areas and housing. The next 10 upstream miles contain substantial agricultural land and some housing areas. Beyond that is sparse agricultural land and National Forest land. Cattle Creek is impacted by several diversions, included diversions out of this watershed to the Lower Middle Roaring Fork Sub-watershed. The creek at the sample location is approximately 12 ft. wide and averages 1 ft. deep with primarily runs. The large percentage of cobble (80 percent) and small amount of silt (20 percent) is not characteristic of this reach. The riparian zone extends approximately 6 ft. from the left bank and 12 ft. from the right bank. Beyond the riparian zone, the surrounding area is predominately fields. Immediately downstream of this site the water in the Glenwood Ditch flows into and mixes with Cattle Creek and then some of the mixed water is diverted back into the Ditch. This sample was located above that mixing point.

The [2006 Roaring Fork Watershed Water Quality Report](#), based primarily on River Watch data, placed this stream on the Impacted List. Selenium and manganese levels exceeded state standards, Macroinvertebrate Family Biotic Index data indicated fairly substantial organic pollution is likely, high levels of suspended solids are present, and damage to or loss of riparian habitat is found throughout much of the lower stream. Exceedances of pH, selenium, and manganese were found at this site ([2008 State of the Roaring Fork Watershed Report](#)). The rocks that outcrop in this sub-watershed act as a source of manganese. Selenium is leached from Mancos Shale that outcrops and underlies Cattle Creek. Cattle Creek is on the 2012 State of Colorado 303(D) list for aquatic life.

Benthic Macroinvertebrate Review:

The MMI score (41.2) was below the impairment threshold indicating that this site was impaired for aquatic life use. Auxiliary metrics (HBI and Diversity) produced mixed results with a Diversity value (3.39) indicating good community balance and an HBI value (6.61) suggesting there was an unhealthy abundance of nutrient-tolerant taxa. Other individual metrics (EPT and Clinger Taxa) supported the impairment designation and produced some of the lowest values for specialized and sensitive taxa in the study area (Table 1). Upstream and surrounding land uses have the potential to impact the aquatic life communities.

Cattle Creek, Hwy 82 Culvert (7888)

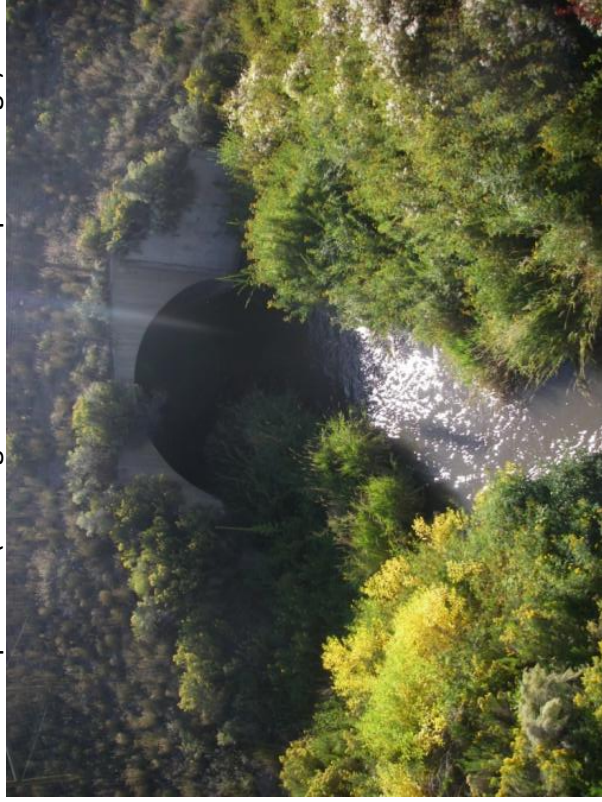
Looking upstream from macro sample site at culvert under Hwy 82



Looking downstream from macro sample site at bike path bridge



Macro sample site (looking down from bike path bridge)



Multi-habitat macro sampling conducted within this area.



Fourmile Creek – Above Sunlight

River/Stream: Fourmile Creek

River Watch Site Name and (Number): Above Sunlight (7890)

WQCD Site ID: 12718A

Coordinates (NAD 83): N 39.404 W -107.3599

Site Description:

This site is located on upper Fourmile Creek, a tributary to the Roaring Fork River near Glenwood Springs. It is located upstream of the Sunlight Ski Area and immediately upstream of the Forest Road 300 culvert. From Glenwood, this site is 10 miles up Fourmile Road (CR 117) and an additional mile on FR 300. Upstream of this site is almost entirely National Forest and BLM lands. This area is heavily used by recreationists and natural resource extraction vehicles as a major route into the area. Much of the Fourmile Creek Watershed has been leased for future natural gas development, although no drilling has occurred yet. The creek at the sample location is approximately 7 ft. wide and averages 0.5 ft. deep with primarily steps and pools. Substrate is predominately cobble/boulder and the riparian zone extends approximately 20 to 30 ft. from either bank. Beyond the riparian zone is primarily natural vegetation.

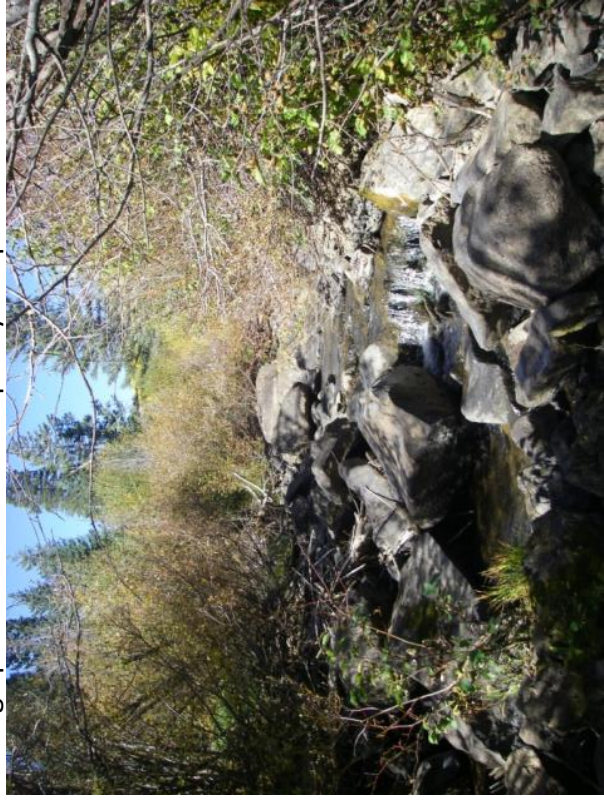
Based on the potential for natural gas development, RFC partnered with Thompson Divide Coalition to conduct the [2009-2011 Thompson Divide Baseline Water Quality Study](#). That study included macroinvertebrate sampling and this Fourmile Creek sampling was done at the same location. Fourmile Creek was found to be healthy, uncontaminated, and able to support significant populations of benthic aquatic organisms.

Benthic Macroinvertebrate Review:

This site is located in Biotype 2 and the MMI score (81.5) produced at this site was well above the threshold for aquatic life use attainment. Other metric values (EPT and Clinger Taxa) produced at this site indicated that healthy aquatic communities existed with relatively high numbers of sensitive and specialized taxa (Table 2). Most of the watershed upstream of this site is National Forest and BLM land. The potential for natural gas development and continued use by recreationalists provide impending threats to the preservation of healthy aquatic conditions. Continued monitoring is recommended to provide early detection and identification of possible impacts to the aquatic communities.

Fourmile Creek, Above Sunlight (7890)

Looking upstream from water quality sample site



Looking downstream from water quality sample site



Water quality sample site



Kick location (upstream of WQ site)



Fourmile Creek – Bershenyi Ranch

River/Stream: Fourmile Creek

River Watch Site Name and (Number): Bershenyi Ranch (785)

WQCD Site ID: 12711

Coordinates (NAD 83): N 39.4867 W -107.316

Site Description:

This site is located on lower Fourmile Creek, a tributary to the Roaring Fork River near Glenwood Springs. It is just downstream of the Fourmile Road (CR 117) culvert over the creek and approximately one mile upstream of the Fourmile Creek confluence with the Roaring Fork River. This site is on the property formerly known as the Bershenyi Ranch. Upstream of this site is a combination of sparse housing and agricultural lands extending approximately nine miles. Sunlight Ski Area is located at mile ten. Significant diversions occur along Fourmile Creek including the Atkinson Ditch which dewateres the stream during dry years in the summer/fall. Enough groundwater and return flows occur below the Atkinson Ditch that this site has water. The creek at the sample location is approximately 10 ft. wide and averages 1.5 ft. deep with primarily steps and pools. Substrate is predominately cobble and the riparian zone extends approximately 15 to 20 ft. from either bank. Beyond the riparian zone is primarily agricultural land with some housing. Recent and historical beaver activity (dams/lodges) exists approximately 100 yards upstream of the sample site.

The [2006 Roaring Fork Watershed Water Quality Report](#), based primarily on River Watch data, placed this stream on the Impacted List for a variety of reasons. Selenium, manganese, and aluminum levels exceeded state standards, Macroinvertebrate Family Biotic Index data indicated that fairly substantial organic pollution is likely, and significant alteration of natural flows is seen from May through October. Exceedances of temperature, total phosphorus, iron, and selenium were found at this site ([2008 State of the Roaring Fork Watershed Report](#)).

Benthic Macroinvertebrate Review:

The combination of housing and agricultural lands, in addition to the Sunlight Ski Area, provided a variety of opportunities for increased stress to aquatic organisms at this site. Potential stress to aquatic life may also result from the multiple upstream diversions. The MMI score produced at this site (75.4) was well above the threshold for aquatic life use attainment; however, some of the individual metrics (EPT and Clinger Taxa) produced values that were indicative of slightly stressed conditions (Table 1). The HBI metric also produced a score (4.28) that indicated a greater proportion of nutrient-tolerant taxa than at other nearby sites. The MMI score indicated that this site maintained healthy aquatic conditions; however, given the variety of potential sources for stress and the response of some individual metrics, it seems likely that minor stress to aquatic life may be present at this site.

Fourmile Creek, Bershenyi Ranch (785)

Looking upstream from macro sample site



Looking downstream from macro sample site



Macro sample site



Kick location



Recommendations

Long-term monitoring studies are essential for the evaluation of aquatic life in systems with increasing water demands or changes in land use practices (Likens and Lambert 1998, Voelz et al. 2005). Sustained biomonitoring studies also provide a better understanding of impacts from anthropogenic disturbances when compared to natural seasonal and annual variation in benthic communities. In this study area, sampling sites with potential changes in surrounding land use or other perturbations should be monitored in the future to evaluate and better understand the potential effects on aquatic life. Sites that were determined to be impaired for aquatic life use should also be monitored in the future, particularly if there is mitigation or other potential changes in the level of stress that may alter aquatic conditions. Data collected at pristine sites, with minimal human activity, provides valuable reference information within the watershed and offers an opportunity to monitor natural annual variations in aquatic life in the study area. The results attained by consistent sampling practices and accurate identifications can provide valuable information regarding short-term and long-term changes in aquatic conditions.

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