



Upper Columbia Basin Network Integrated Water Quality Annual Report 2010

Craters of the Moon National Monument and Preserve (CRMO)

Natural Resource Data Series Natural Resource Data Series NPS/UCBN/NRDS—2011/149



ON THE COVER

Little Cottonwood Creek, 22 June 2010 Craters of the Moon National Monument and Preserve
Photograph courtesy of Eric Starkey

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*Craters of the Moon National Monument and Preserve
(CRMO)*



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Contents

	Page
List of Figures	v
List of Tables	vii
List of Appendices	ix
Executive Summary	xi
Acknowledgments.....	xiii
Introduction and Background	1
Objectives	2
Study Area	5
Little Cottonwood Creek – Craters of the Moon National Monument and Preserve (CRMO)	5
Monitoring Sites.....	7
Methods.....	13
Water Chemistry	13
Discharge	14
Macroinvertebrates	14
Results and Discussion	15
Water Chemistry	15
Macroinvertebrates	20
Literature Cited	23

Figures

	Page
Figure 1. Craters of the Moon National Monument (NPS 1998).....	8
Figure 2. Water quality monitoring locations in Little Cottonwood Creek 2010.....	9
Figure 3. Little Cottonwood Creek drainage, looking downstream towards the highway and visitors center.....	10
Figure 4. Little Cottonwood Creek and riparian vegetation.	10
Figure 5. Little Cottonwood Creek, looking upstream, June 2008.....	11
Figure 6. Water temperature in Little Cottonwood Creek, 22-23 June 2010.....	17
Figure 7. Specific conductance in Little Cottonwood Creek, CRMO, 22-23 June 2010.....	17
Figure 8. Dissolved oxygen in Little Cottonwood Creek CRMO, 22-23 June 2010.....	18
Figure 9. pH in Little Cottonwood Creek, CRMO 22-23 June 2010.....	18
Figure 10. Corrected turbidity in Little Cottonwood Creek 22-23 June 2010.....	19
Figure 11. Percent order composition in Little Cottonwood Creek, June 2010.....	22
Figure 12. Percent family composition in Little Cottonwood Creek, June 2010.....	22

Tables

Page

Table 1. Vital sign summary table for water chemistry in Little Cottonwood Creek, 22-23 June 2010.....	15
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Table 2. Vital sign summary table for benthic macroinvertebrates in Little Cottonwood Creek, 2010. Sample reach 001.....	21
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Appendices

	Page
Appendix A. 2010 Water Quality Monitoring Locations in CRMO	25
Appendix B. CRMO Hydrologic Unit Code Boundaries	27
Appendix C. Sample Locations for Water Quality Monitoring at CRMO	29
Appendix D. 2010 Water Quality Photo Point Locations at CRMO	31
Appendix E. Quality Control (QC) Indicators	33
Appendix F. Corrections History	35
Appendix G. Summary Information for Each Macroinvertebrate Sample Reach	37
Appendix H. Macroinvertebrate Metrics	39
Appendix I. Macroinvertebrate Taxa List.....	41

Executive Summary

The mission of the National Park Service is “to conserve unimpaired the natural and cultural resources and values of the national park system for the enjoyment of this and future generations” (NPS 1999). To uphold this goal, the Director of the NPS approved the Natural Resource Challenge to encourage national parks to focus on the preservation of the nation’s natural heritage through science, natural resource inventories, and expanded resource monitoring (NPS 1999). Through the Challenge, 270 parks in the national park system were organized into 32 inventory and monitoring networks.

The Upper Columbia Basin Network (UCBN) has identified 14 priority park vital signs, indicators of ecosystem health, which represent a broad suite of ecological phenomena operating across multiple temporal and spatial scales. The intent of the network, is to monitor a balanced and integrated “package” of vital signs that meets the needs of current park management, but will also be able to accommodate unanticipated environmental conditions in the future. Water quality is a particularly high priority vital sign for six of the nine UCBN parks. The UCBN contains more than 34 rivers, streams, ponds, and reservoirs located in nine park units spread over four large western states. Unlike many National Parks that are large and often encompass entire watersheds, most UCBN parks and water bodies are small and embedded in large watersheds with diverse land use.

A continuous water quality monitor (Hydrolab) was deployed at a single site for 24 hours in Little Cottonwood Creek within CRMO. The deployment interval was only 24 hours (June 22-23rd) due to the influent nature of the stream. In a “typical” water year, a large portion of the stream is nearly dry by mid July. The core parameters measured were water temperature, dissolved oxygen, pH, specific conductance, and turbidity. These core parameters were measured every half hour, and the instrument was retrieved and serviced at the end of the deployment period. Macroinvertebrates were sampled using protocols established by the Environmental Protection Agency (EPA) Environmental Monitoring and Assessment Program (EMAP) (Peck et al. 2006). The single sample reach was 150 m in length and included 11 transects. Samples for each transect were combine to form a single composite for the entire reach.

This annual report details the status of key indicators of water quality obtained from the first season of monitoring in Craters of the Moon National Monument and Preserve (CRMO), 2010.

Note that several of the appendices in this report are primarily intended for UCBN internal reference. In addition, some appendices serve as hard copies of quality assurance/quality control procedures performed during data processing. Data from the 2010 field sampling effort was collected following methods detailed in the UCBN integrated water quality monitoring protocol (Starkey et al. 2008). The UCBN Integrated Water Quality Monitoring Protocol was formally peer-reviewed and approved for implementation in August 2009. This protocol can be found on the UCBN website at:

http://science.nature.nps.gov/im/units/ucbn/reports/index.cfm#IWQ_Mon

Water chemistry and macroinvertebrate results indicate that the Little Cottonwood Creek is in good condition, with no issues of concern at this time. The status of water quality for Little

Cottonwood Creek relative to state regulatory thresholds was not assessed due to the lack of established total maximum daily loads (TMDLs).

UCBN water quality monitoring is conducted on a 3 year rotating panel. As a result, conditions in Little Cottonwood Creek will be re-evaluated in 2013.

Little Cottonwood Creek (CRMO) Water Chemistry Summary for 24 Hour Period 22-23 June, 2010

Measure	Current Condition (June 22-23, 2010)	NPS Baseline Data 1998 (Site CRMO0021 Upper Little Cottonwood)	State DEQ Thresholds***
Temperature	MDMT* = 10.45 °C MDAT** = 10.45 °C	mean = 9.13 °C max. = 15.0 °C	MDMT < 22 °C, MDAT < 19 °C
Specific conductance	mean = 223.97 µS/cm	mean = 160.86 µS/cm max. 228 µS/cm	Not designated
Dissolved oxygen	daily min = 8.8 mg/L	mean = 7.92 mg/L min = 5.4 mg/L	> 6.0 mg/L
pH	daily max = 8.8 pH Units	max. = 8.0 pH Units	< 9.0 pH Units
pH	daily min = 8.56 pH Units	min = 6.2 pH Units	> 6.5 pH Units
Turbidity	daily max < 0.2 NTU	max. 3.4 NTU	< 50 NTU (instantaneous), < 25 NTU for 10 consecutive days

*MDMT – Maximum Daily Maximum Temperature **MDAT – Maximum Daily Average Temperature

***Note that Little Cottonwood Creek is considered "undesignated surface water" meaning that it has not been assigned a beneficial use. In Idaho undesignated streams are assumed to support cold water aquatic life and primary or secondary contact recreation. As a result, the state thresholds listed above are the criteria for cold water aquatic life.

Acknowledgments

Funding for this project was provided through the National Park Service Natural Resource Challenge and the Servicewide Inventory and Monitoring Program. We thank John Apel of CRMO for accommodations in the park group camp during field work.

Introduction and Background

Water resources have been identified as a high priority vital sign for the UCBN. These resources are used by many riparian, migratory, and terrestrial organisms in the Network, and have intrinsic value as places of natural beauty and recreation (Garrett et al. 2007). Reflecting this priority, the Water Resources Division (WRD) of the NPS provides a separate source of funding each fiscal year to the Upper Columbia Basin Network (UCBN) to accomplish water quality monitoring. In June 2010 the UCBN began its first year of integrated water quality monitoring in the Little Cottonwood Creek at Craters of the Moon National Monument and Preserve (CRMO).

Water resources in the semi-arid west have been strongly affected by human activity, and many UCBN streams and rivers are listed by states as impaired for one or more parameters. Most UCBN water bodies and many aquatic resources such as migratory fish are strongly influenced by activities in the larger watersheds outside park boundaries. Understanding the current status of freshwater ecosystems will help guide management and restoration efforts, and provide insight into ecosystem change in a landscape with a shifting climate and dynamic human influences.

During the process of prioritizing vital signs to monitor in UCBN parks in 2005, water quality was identified as a high priority vital sign (Garrett et al. 2007). When asked what aspects of water quality were important to monitor, resource managers identified the sampling of macroinvertebrate assemblages within UCBN water bodies as the top water quality monitoring priority. Secondary priorities included baseline sampling of water chemistry parameters, characterization of channel morphology, and information on water quantity. Channel morphology and riparian vegetation will be addressed in separate monitoring protocols which are under development.

The foci of the UCBN Integrated Water Quality Monitoring Protocol are aquatic macroinvertebrate assemblage composition and water chemistry. Aquatic macroinvertebrate assemblages have strong effects on freshwater ecosystem processes and represent an important trophic linkage between primary producers and fishes. Measures of macroinvertebrate assemblage composition and structure have been frequently used as water quality indicators because these assemblages integrate the effects of point and non-point source pollutants over spatial-temporal scales and can be used to answer many management questions. Also, macroinvertebrates are more cost-effective to sample than other biota or many water chemistry parameters.

Water chemistry and temperature have strong effects on aquatic biota. Consequently, direct and indirect human alteration of stream water quality is associated with altered biotic communities and ecosystem processes. Because of the direct relationship between water chemistry and biota, water chemistry is typically a central component of any water quality monitoring program. More recently, monitoring of stream water temperatures has increased in the Pacific Northwest, because of concerns over cold-water fish habitat (primarily salmonid fishes), the recognized influence of land- and water-use on stream temperature regime, and the need for baseline temperature information to monitor the effects of climate change. National Park Service (NPS) Water Resource Division (WRD) has identified a suite of four “core water quality parameters”, temperature, specific conductance, pH, and dissolved oxygen, which are critical to understanding

baseline conditions in aquatic habitats. The UCBN added turbidity as a parameter to measure because turbidity is listed as a source of impairment in several UCBN park streams.

Well articulated desired future condition statements have not yet been developed for water quality in UCBN parks. However, the mission statements for the NPS as a whole and for the individual parks clearly state the intent “to conserve unimpaired the natural and cultural resources and values of the national park system for the enjoyment of this and future generations” (NPS 1999). Water quality is a particularly important resource with nationally recognized merit. It is assumed that desired future conditions for all UCBN parks will include clean streams, rivers, and lakes free of human health concerns that provide visitors with recreational and scenic experiences. Monitoring macroinvertebrate assemblage composition and structure, and core water quality parameters, will directly measure the water characteristics most important to park mission, visitor experience, and desired future conditions.

Objectives

The overarching programmatic goal of the UCBN integrated water quality monitoring program is to obtain information that will aid in informed management decisions pertaining to improved water quality within UCBN parks. Park managers have committed to improving the water quality of impaired waters by adopting the NPS Government Performance Results Act (GPRA) goal (1a4) that streams and rivers managed by NPS will meet State and Federal water quality standards (NPS 2000). Given this goal, it should be noted that Little Cottonwood Creek is considered “undesignated surface water,” meaning that it has not been assigned a beneficial use. In Idaho undesignated streams are assumed to support cold water aquatic life and primary or secondary contact recreation (ID Admin Code 2010, 58.01.02.101.01a [through 4/5/00]). Little Cottonwood Creek has not been assessed for inclusion on the EPA 303(d) list and thus, lacks total maximum daily loads (TMDLs) (Garrett et al. 2007).

Given the lack of available data on water quality in UCBN parks, the following fundamental questions drive much of the UCBN’s inquiry into water quality:

- Are the core water quality parameters of streams in the UCBN with established TMDLs selected for sampling improving over time?
- What is the status and long-term trend of core water quality parameters (temperature, pH, conductivity, dissolved oxygen, and turbidity) in UCBN streams selected for sampling?
- What is the status and long term trend in aquatic macroinvertebrate abundance and assemblage composition in selected UCBN streams?
- Do aquatic macroinvertebrate assemblages sampled within UCBN streams indicate polluted or otherwise impaired water quality?
- Do aquatic macroinvertebrate assemblages sampled within UCBN streams indicate “pristine” or “reference” conditions according to regional criteria established by EPA and the states of Idaho, Oregon, Montana, and Washington?

In light of these questions and the broader goals outlined above, water quality monitoring in the UCBN addresses the following specific measurable monitoring objectives:

- Determine status and long term trend in key water quality parameters for selected streams within UCBN park units.
- Determine status and trend in aquatic macroinvertebrate abundance, assemblage composition, and functional feeding group composition in wadeable streams within the UCBN.

Study Area

Little Cottonwood Creek – Craters of the Moon National Monument and Preserve (CRMO)

Little Cottonwood Creek is in the Big Lost Subbasin (Hydrologic Unit Code [HUC] 17040218) and in the Big Lost River Sinks Watershed (HUC 1704021808) in Butte County, Idaho. The Big Lost River Sinks Watershed encompasses 1303.63 square km. It is important to note that the HUC designation for Little Cottonwood Creek changed in 2009. The old designation was 17040209- Lake Walcott Subbasin. The subbasin was changed due to the way the boundaries were delineated (USGS, NRCS 2009). As a result, reports and maps prior to 2009 use the older HUC designation.

Little Cottonwood Creek originates from springs within CRMO, in the foothills of the Pioneer Mountains (Figures 1 and 2) and is a 1st order stream. In 1992 and 1993, Falter and Freitag (1996) found that mean stream discharge was between 0.10 cfs and 0.52 cfs. The maximum recorded discharge during their evaluation of water quality occurred in June 1993 and was 1.13 cfs. Flow severity estimates during UCBN field work indicated that in June 2010 flow was “normal” (see Starkey et al. 2008 for a description of flow severity categories). Little Cottonwood Creek flows year round, making it a perennial stream. Despite persistent water in the upper portion of the creek, the entire stream flow infiltrates into the substrate as the valley becomes less constrained. Streams of this type are known as influent streams. Even when the middle and upper sections of Little Cottonwood Creek have a wetted width of 1 m and moderate flows, there is no trace of surface flow as the creek crosses under the road near the field station (previously known as “research camp”) (Figures 3-5). As a result of its influent nature, the Little Cottonwood Creek has no connectivity to other streams, thereby limiting the dispersal of aquatic organisms.

The primary land cover types for CRMO as determined from the National Land Cover Dataset and the National Park Service digital park unit layer include Bare Rock/Sand/Clay (81%), Shrubland (18%), Grasslands/Herbaceous (1%), Woody Wetlands (<1%), Agriculture (<1%), and Urban (<1%) (Garrett et al. 2007). However, in the Little Cottonwood Creek drainage the landcover consists almost exclusively of Shrubland, Grassland/Herbaceous and Woody Wetlands (Figures 3-5). Riparian vegetation has been best classified by Bell et al. (2009) during the vegetation inventory project (vegetation mapping). Bell et al. noted the following associations near Little Cottonwood Creek:

- *Riparian and Wetland Forest and Woodland Associations* – Stands varied according to the availability of water and tended to be dominated by quaking aspen, black cottonwood, and Douglas-fir on slopes and canyon bottoms. Associated mesic shrubs often included chokecherry (*Prunus virginiana*), mountain snowberry (*Symphoricarpos oreophilus*), and mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), in addition to pinegrass (*Calamagrostis rubescens*) (Excerpted from Bell et al. 2009).
- *Riparian and Wetland Shrubland Associations* - Riparian and wetland shrubland associations of CRMO were characterized by speckled alder (*Alnus incana*), chokecherry, and rubber rabbitbrush (*Chrysothamnus nauseosus*). The channels of intermittent washes

supported sparse shrub communities dominated by rubber rabbitbrush and basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) (Excerpted from Bell et al. 2009).

- *Riparian and Wetland Herbaceous Associations*-Mesic riparian and wetland herbaceous associations at CRMO were uncommon, limited in their distribution, and were represented by Baltic rush (*Juncus balticus*), basin wildrye (*Leymus cinereus*), and western wheatgrass (*Pascopyrum smithii*). All stands were restricted to areas with water at or near the surface for some or all of the growing season as occur along some perennial drainages, Lava and Huff lakes and Carey Lake Marsh (Excerpted from Bell et al. 2009).

The substrate in Little Cottonwood Creek ranges from fine sand (< 2 mm) to coarse cobbles (> 64 mm). During benthic macroinvertebrate sampling, 36.4 % of samples came from fine, 45.5 % from gravel (2-64 mm) and 18.2 % from coarse substrates (Appendix G). This distribution of substrate is representative of what was observed throughout the creek during field work.

Little Cottonwood Creek is of special importance to CRMO because its headwater springs served as the source of water for park headquarters until 2004. Since then, the park water supply has come from shallow wells along the downstream end of the creek (Figure 3). As a result, water quality in Little Cottonwood Creek has a direct impact on water use within the park.

General threats to water resources in CRMO have been listed as: Pesticide runoff and drift from agricultural lands, as well as weed management activities along state and county roads (Garrett et al. 2007). However, most of the above threats are not applicable to Little Cottonwood Creek due to its isolation, undeveloped drainage, and lack of connectivity to other streams.

The primary concern in Little Cottonwood Creek is impacts caused by the historic Martin Mine. This mine was most active during the mid 1920s and mid 1930s with some limited use in the 1950s. In 1967 NPS acquired the claim. Subsequently, in the early 1980s, CRMO filled in the mine shaft and tunnels. In 1994 remediation/restoration of the hillside occurred (NPS 1995). The 1998 NPS Water Resource Division report on baseline water quality data and Falter and Freitag (1996) describes water quality in more detail relative to the Martin Mine. Falter and Freitag (1996) stated that the “Martin Mine is minimally influencing the metals content of Little Cottonwood Creek” and that lead and arsenic levels fall “well below the EPA’s criteria for domestic and irrigation water supplies.”

As stated in the objectives section above, Little Cottonwood Creek is considered “undesignated surface water,” meaning that it has not been assigned a beneficial use. In Idaho undesignated streams are assumed to support cold water aquatic life and primary or secondary contact recreation. Little Cottonwood Creek has not been assessed for inclusion on the EPA 303(d) list and thus, lacks total maximum daily loads (TMDLs) (Garrett et al. 2007).

Monitoring Sites

Water Chemistry

The water chemistry monitoring site was approximately 800 m downstream from the headwaters in a shallow pool. The continuous water quality sonde (Hydrolab) was deployed 580 meters upstream from where the 2-track road crosses the creek (Figure 2). This location was chosen due to adequate water depth and position above the benthic macroinvertebrate monitoring reach. It should be noted that this location is upstream of the historic Martin Mine. The water chemistry monitoring site was not located downstream of the mine due to the lack of adequate water depth. In addition, NPS baseline studies (NPS 1998, Falter and Freitag 1996) more adequately evaluated contaminants of concern than is possible with a continuous water quality monitor (Hydrolab) and a single sample location.

Benthic Macroinvertebrates

The benthic macroinvertebrate sample reach is approximately 1,000 m downstream from the headwaters. The center of the macroinvertebrate sample reach (X-site) is 435 m upstream of where the 2-track road crosses the creek (Figure 2). This section of stream was chosen for the macroinvertebrate reach because it is far enough downstream from the headwaters to have adequate water for sampling, yet far enough upstream to have adequate water in late June. Just as the water chemistry site, the macroinvertebrate reach fell upstream of the old Martin Mine.

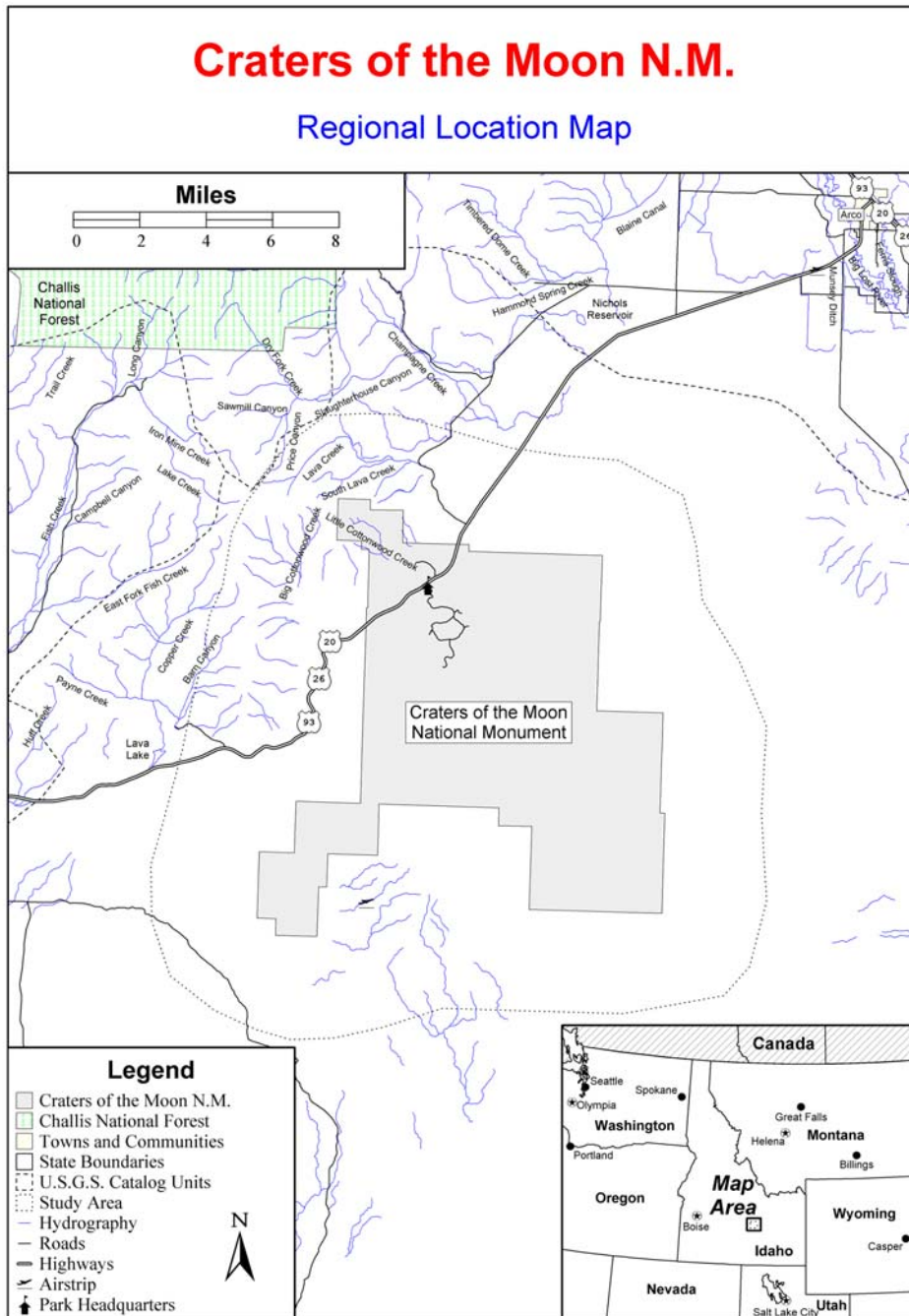


Figure 1. Craters of the Moon National Monument (NPS 1998). Note that this map does not include the expanded preserve (to the South West) created in 2000.



CRMO Water Quality Monitoring 2010

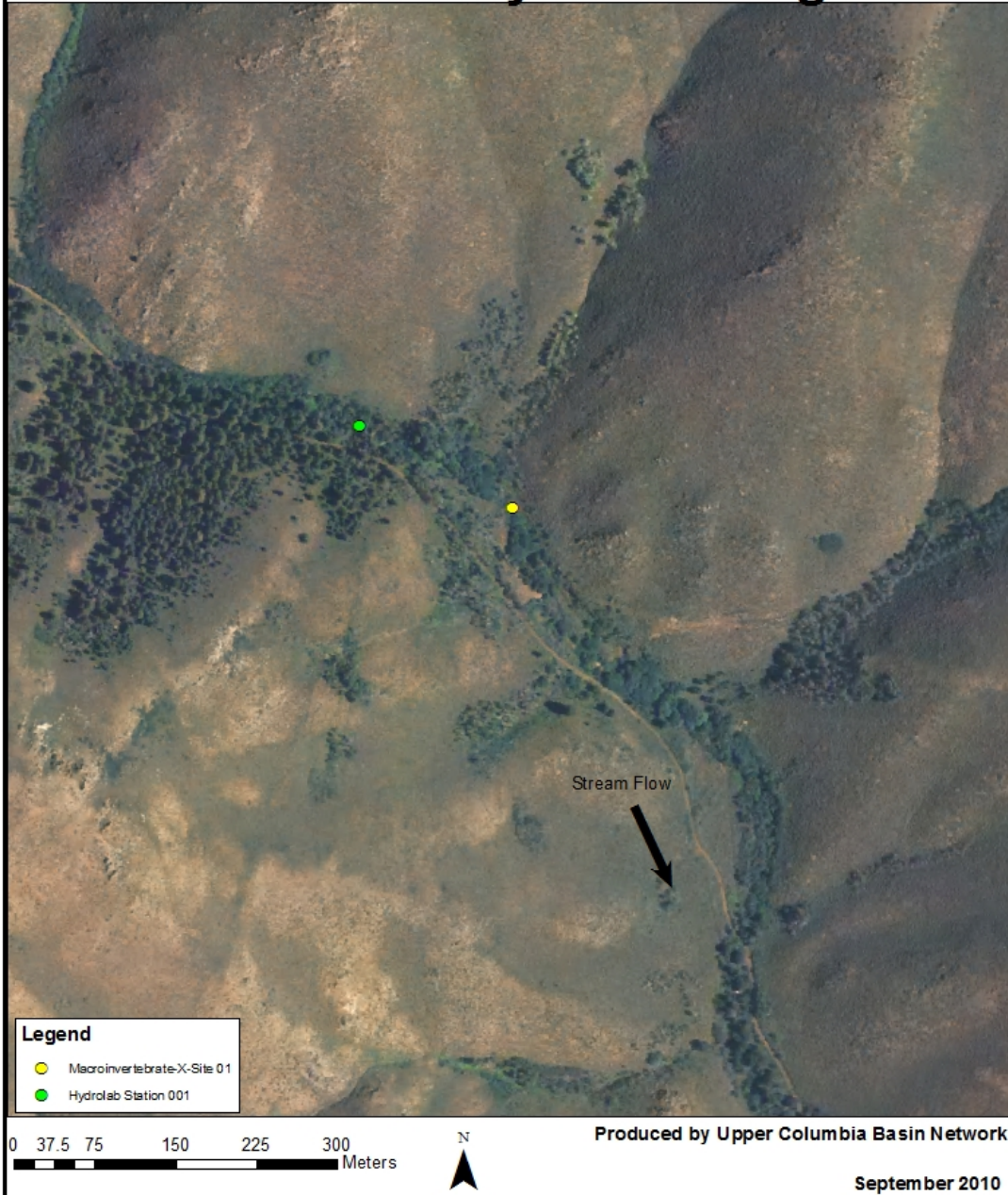


Figure 2. Water quality monitoring locations in Little Cottonwood Creek 2010. Note the 2-track road that runs parallel to and crosses the stream.



Figure 3. Little Cottonwood Creek drainage, looking downstream towards the highway and visitor center. Note that the riparian vegetation in the background is the approximate location where surface flow ceases (Figure 5).



Figure 4. Little Cottonwood Creek and riparian vegetation. Wetted width is approximately 1 m.



Figure 5. Little Cottonwood Creek, looking upstream, June 2008. The stream channel was dry near the field station (aka research camp), despite flowing water and a wetted width of 1 m approximately 1 km upstream from this point.

Methods

Water Chemistry

A continuous water quality monitor (Hydrolab) was deployed at a single site for 24 hours in Little Cottonwood Creek within CRMO. The deployment interval was 24 hours instead of six months due to the influent nature of the stream and lack of adequate water depth. In a “typical” water year, a large portion of the stream is nearly dry by mid July. The core parameters measured were water temperature, dissolved oxygen, pH, specific conductance, and turbidity. These core parameters were measured every half hour, the instrument was retrieved and serviced at the end of the deployment period. Service to the Hydrolab included the standard evaluation of drift and re-calibration of sensors if necessary. Fouling was not assessed due to the absence of any foreign material on the sensors when it was retrieved. Data quality ratings were determined by the degree of sensor drift. For more information on the UCBN water chemistry sampling design see Starkey et al. (2008).

Cross Section Survey

Given the short deployment interval (24hours) and lack of water deep enough to permanently deploy the Hydrolab, no cross section surveys were conducted.

Quality Assurance/Quality Control (QA/QC)

Quality assurance and quality control for multiprobe data collection are covered in detail in SOP #12 (Starkey et al. 2008). Basic procedures adhere to the guidelines established in Part B lite (Irwin 2008); the National Coastal Assessment Quality Assurance Project Plan 2001-2004 (U.S. EPA 2001); the Laboratory Methods Manual-Estuaries, Volume 1: Biological and Physical Analyses (U.S. EPA 1995); and Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers (Barbour et al. 1999).

General quality assurance and quality control methods for UCBN water quality multiprobe calibration and data downloads include the following:

- The UCBN follows pre-established maximum acceptable differences for field instrument calibration and QC checks. If the multiprobe readings are outside of the maximum acceptable differences the multiprobe is removed for non-routine maintenance.
- When calibrating the multiprobe, values of known standard solutions are measured pre and post calibration, to help determine if the instrument’s measurements have “drifted.” In addition, repeated measures of these solutions are used to determine the repeatability of multiprobe measures.
- All multiprobe data is visually checked for outliers and QC issues immediately following the download of data. QC issues indicated by the data may include: wiper parking, defective sensors, power supply problems, and other anomalies affecting data quality.
- Quantitative and qualitative terms that describe how accurate data need to be in order to meet project objectives are discussed in detail in SOP #12 Starkey et al. 2009 and Appendix E in this report. NPS WRD lists the following data quality objectives as

necessary for water chemistry data: target population, representativeness, completeness, data comparability, measurement sensitivity and detection limits, measurement precision as repeatability, and measurement systematic error/bias.

More detailed QA/QC for water quality multiprobes is contained in SOP #6 and 12 of Starkey et al. 2009.

Discharge

No USGS gaging station exists on the Little Cottonwood Creek; as a result, no discharge data or results are presented in this report. Flow severity was estimated qualitatively as advised by NPS water resource division. Categories include: dry, no flow, low, normal, above normal, and flood (see Starkey et al. 2008 for a description of each).

Macroinvertebrates

Macroinvertebrates were sampled using protocols established by the Environmental Protection Agency (EPA) Environmental Monitoring and Assessment Program (EMAP) (Peck et al. 2006). The single sample reach was 150 m in length and included 11 transects that were permanently marked on the left bank. Macroinvertebrate samples were taken at each transect and composited as a single sample for each reach. Macroinvertebrates were collected several weeks before the preferred index period July-October due to the influent nature of the stream. In a “typical” water year, a large portion of the stream is nearly dry by mid July. For more information on the UCBN macroinvertebrate sampling design see Starkey et al. 2008.

Results and Discussion

Water Chemistry:

Status:

Condition of core water quality parameters are given in Table 1. This table also includes Idaho Department of Environmental Quality (DEQ) regulatory thresholds (surface water criteria) for cold water aquatic life. Note that cold water criteria apply because Little Cottonwood Creek has no designated beneficial uses. Results from 2010 should be considered baseline data as there has been relatively limited sampling of Little Cottonwood Creek in the past. Most existing water chemistry data comes from the NPS Baseline Water Quality Data Inventory and Analysis for CRMO (NPS 1998). Table 1 also includes results from this report for the 5 core parameters measured by the UCBN.

Table 1. Vital sign summary table for water chemistry in Little Cottonwood Creek, 22-23 June 2010.

Little Cottonwood Creek (CRMO) Water Chemistry Summary for 24 Hour Period 22-23 June, 2010			
Measure	Current Condition (June 22-23, 2010)	NPS Baseline Data 1998 (Site CRMO0021 Upper Little Cottonwood)	State DEQ Thresholds***
Temperature	MDMT* = 10.45 °C MDAT** = 10.45 °C	mean = 9.13 °C max. = 15.0 °C	MDMT < 22 °C, MDAT < 19 °C
Specific conductance	mean = 223.97 µS/cm	mean = 160.86 µS/cm max. 228 µS/cm	Not designated
Dissolved oxygen	daily min = 8.8 mg/L	mean = 7.92 mg/L min = 5.4 mg/L	> 6.0 mg/L
pH	daily max = 8.8 pH Units	max. = 8.0 pH Units	< 9.0 pH Units
pH	daily min = 8.56 pH Units	min = 6.2 pH Units	> 6.5 pH Units
Turbidity	daily max < 0.2 NTU	max. 3.4 NTU	< 50 NTU (instantaneous), < 25 NTU for 10 consecutive days

*MDMT – Maximum Daily Maximum Temperature, **MDAT – Maximum Daily Average Temperature

***Note that Little Cottonwood Creek is considered “undesignated surface water” meaning that it has not been assigned a beneficial use. In Idaho undesignated streams are assumed to support cold water aquatic life and primary or secondary contact recreation. As a result, the state thresholds listed above are the criteria for cold water aquatic life.

- Temperature:

During the period of observation, the maximum daily water temperature was 10.45 °C. The NPS Baseline Water Quality Data Inventory and Analysis for CRMO (Site CRMO0021 Upper Little Cottonwood) (1998) indicates that between May 1992 and August 1997, the maximum observed temperature was 15 °C (n = 22). Despite the relatively short duration of monitoring, current conditions indicate that Little Cottonwood creeks temperatures are within acceptable ranges and do not exceed criteria for cold water aquatic life (Figure 6). This is in large part due to the fact that it is spring fed, well shaded by riparian vegetation, and has no tributaries. The data quality for this deployment is rated as “Excellent” based on

the assessment of sensor drift. In addition, no data corrections were necessary due to drift or outliers (Wagner et al. 2006).

- **Specific Conductance:**
During the period of observation, the mean specific conductance was 223.97 $\mu\text{S}/\text{cm}$ (Figure 7). The NPS Baseline Water Quality Data Inventory and Analysis for CRMO (Site CRMO0021 Upper Little Cottonwood) (NPS 1998) indicates that between May 1992 and August 1997, the mean specific conductance was 160.86 $\mu\text{S}/\text{cm}$ and the maximum was 228 $\mu\text{S}/\text{cm}$ ($n = 22$). The data quality for this deployment is rated as “Excellent” based on the assessment of sensor drift (Wagner et al. 2006). In addition, no data corrections were necessary due to drift or outliers.
- **Dissolved Oxygen:**
During the period of observation, dissolved oxygen was between 8.8 and 9.5 mg/L, with a mean of 9.13 mg/L (Figure 8). This range of dissolved oxygen is well within the acceptable range for streams supporting cold water aquatic life. The NPS Baseline Water Quality Data Inventory and Analysis for CRMO (Site CRMO0021 Upper Little Cottonwood) (NPS 1998) indicates that between May 1992 and August 1997, the minimum dissolved oxygen was 5.4 mg/L ($n = 22$). This level of dissolved oxygen is lower than the surface water criteria established for cold water aquatic life (> 6.0 mg/L). It should be noted that no cold water fishes (salmonids) have been reported in Little Cottonwood Creek as of 2005 (NP Species: Accessed 10 September 2010). The data quality for this deployment is rated as “Excellent” based on the assessment of sensor drift. In addition, no data corrections were necessary due to drift or outliers (Wagner et al. 2006).
- **pH:**
During the period of observation, pH ranged from 8.56 to 8.8 pH units (Figure 9) and never exceeded the criteria for cold water aquatic life (6.5-9.0 pH units). The NPS Baseline Water Quality Data Inventory and Analysis for CRMO (Site CRMO0021 Upper Little Cottonwood) (NPS 1998) indicates that between May 1992 and August 1997, pH ranged from 6.2 to 8.0 pH units ($n = 22$). This baseline data suggests that Little Cottonwood Creek may occasionally dip below the pH criteria for cold water for aquatic life. The data quality for this deployment is rated as “Excellent” based on the assessment of sensor drift (Wagner et al. 2006). In addition, no data corrections were necessary due to drift or outliers.
- **Turbidity:**
Mean, max and minimum turbidity during the period of observation was < 0.2 NTU (Figure 10). The NPS Baseline Water Quality Data Inventory and Analysis for CRMO (Site CRMO0021 Upper Little Cottonwood) (NPS 1998) indicates that between May 1992 and August 1997, turbidity ranged from 0.8 to 3.4 NTU with a mean of 1.38 NTU ($n = 11$). All turbidity values are well below criteria established for cold water aquatic life (< 50 NTU [instantaneous]). The data quality for this deployment is rated as “Excellent” based on the assessment of sensor drift (Wagner et al. 2006). Turbidity data was corrected by removing two extreme outliers likely caused by air bubbles.

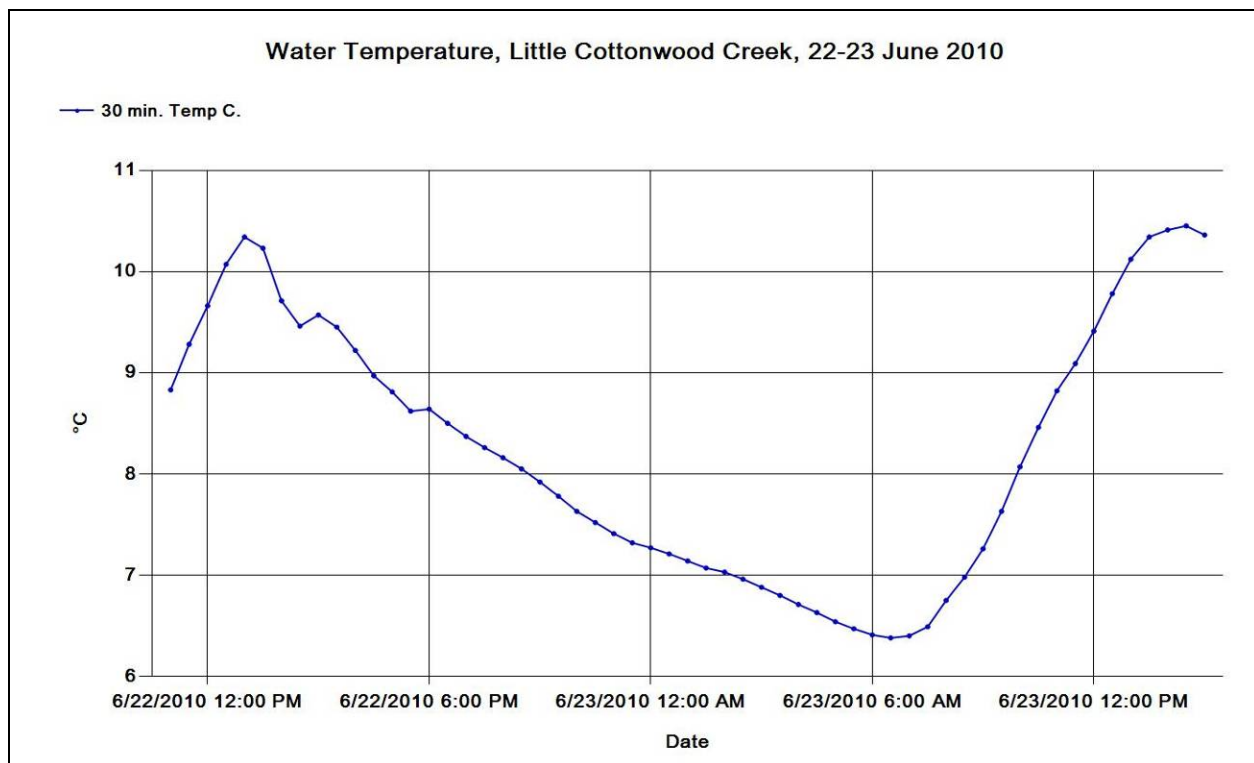


Figure 6. Water temperature in Little Cottonwood Creek, 22-23 June 2010.

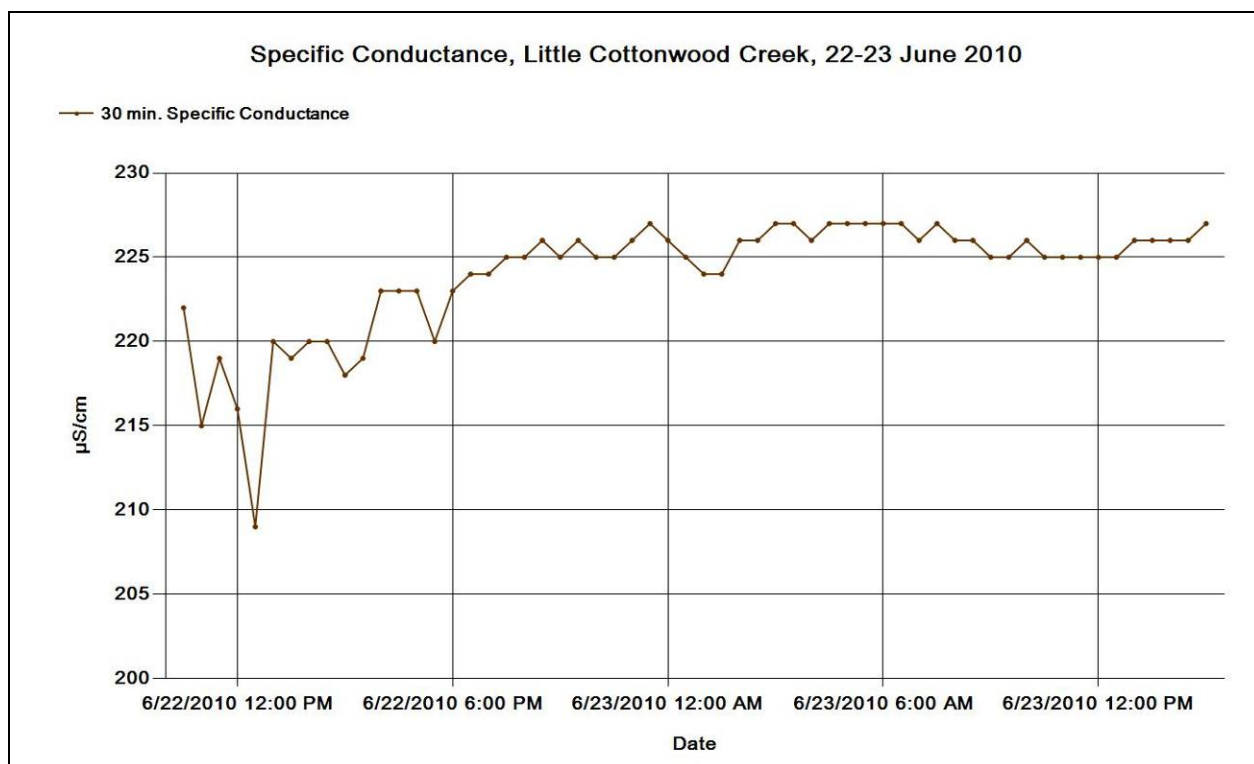


Figure 7. Specific conductance in Little Cottonwood Creek, CRMO, 22-23 June 2010.

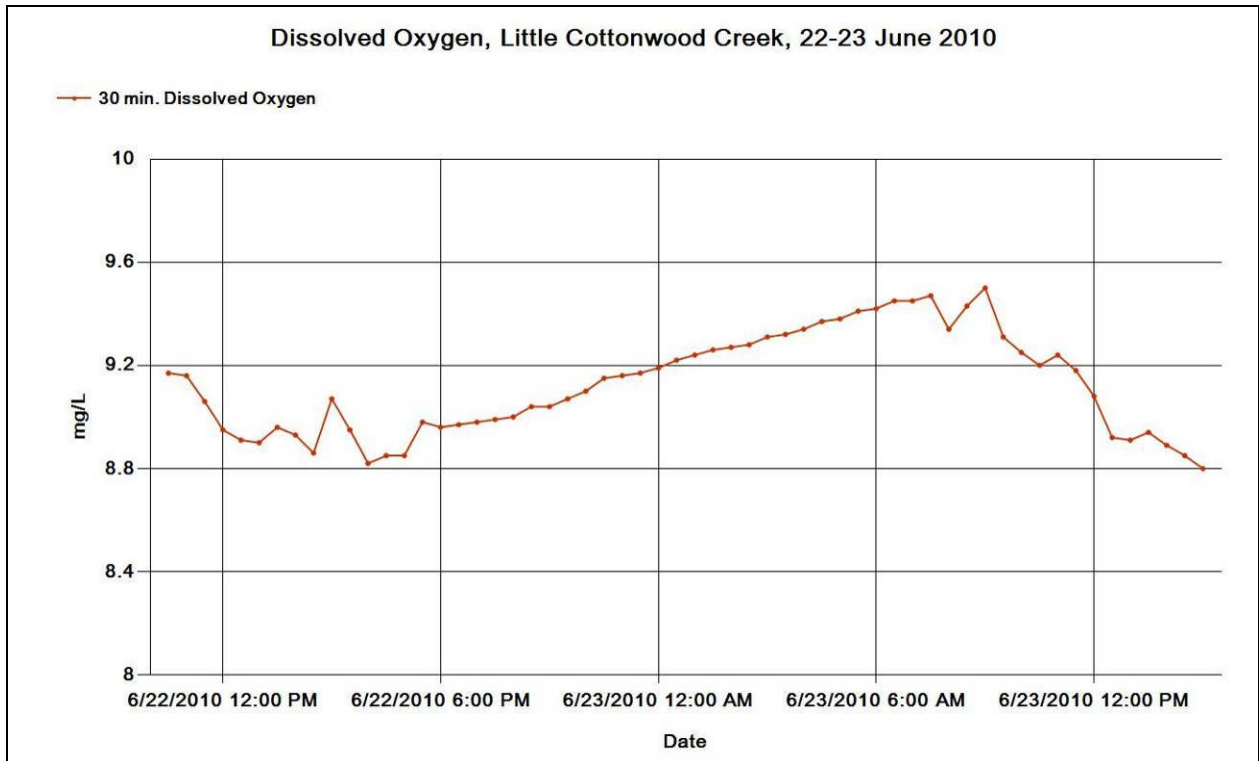


Figure 8. Dissolved oxygen in Little Cottonwood Creek CRMO, 22-23 June 2010.

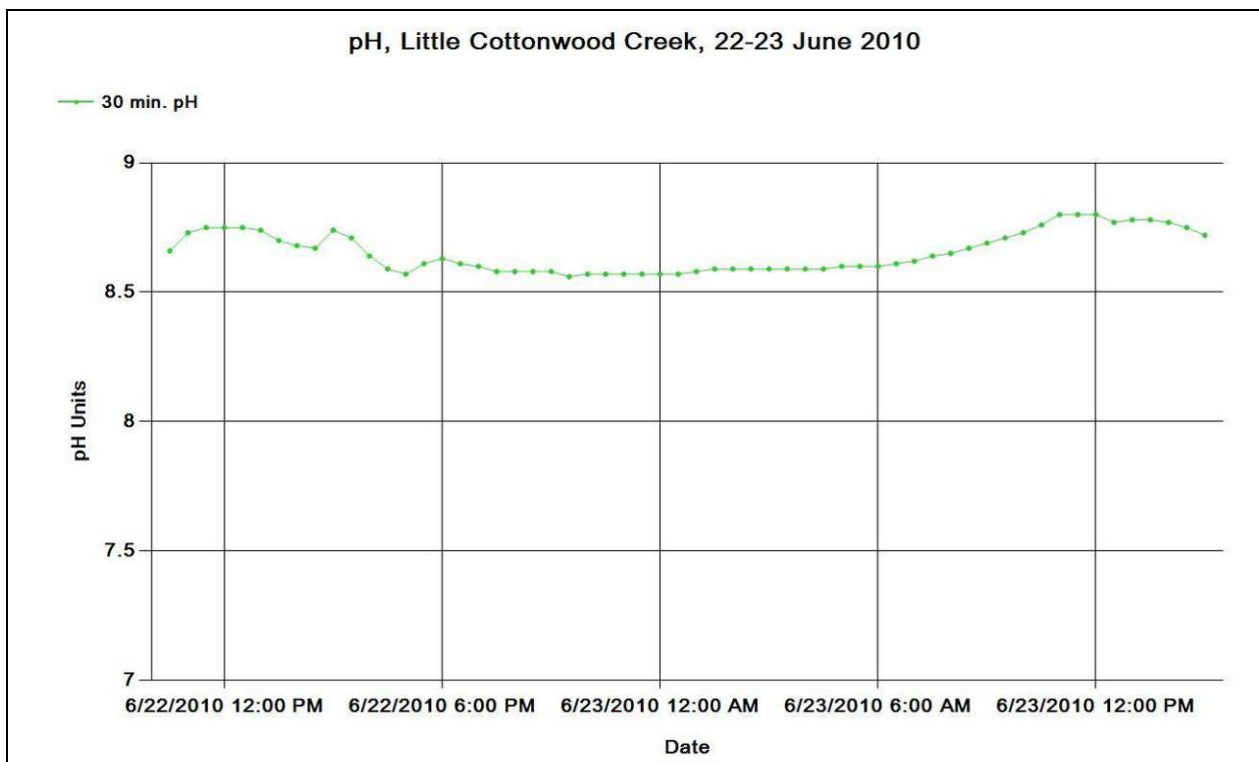


Figure 9. pH in Little Cottonwood Creek, CRMO 22-23 June 2010.

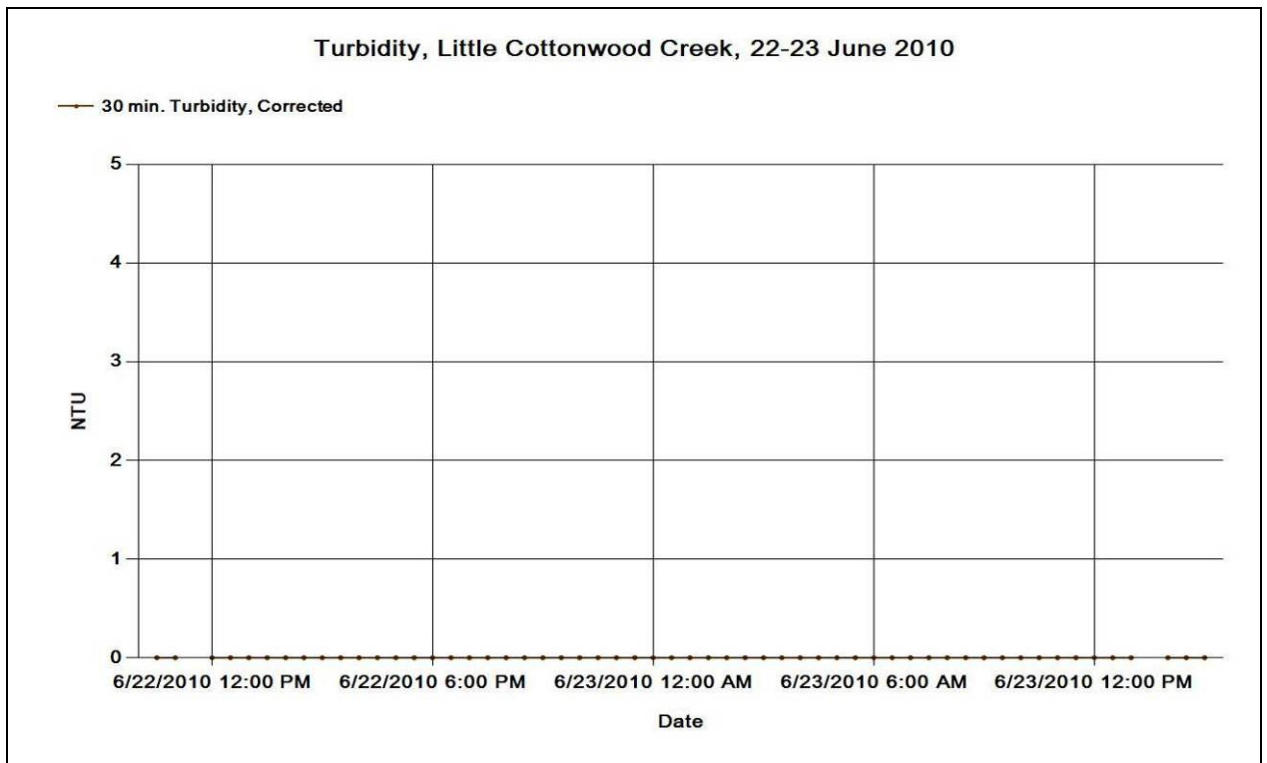


Figure 10. Corrected turbidity in Little Cottonwood Creek 22-23 June 2010.

Macroinvertebrates

Status:

The Hilsenhoff Biotic Index (HBI) is a summary of the pollution tolerances of organisms collected in the sample. This index is typically used to detect organic pollution (nutrient enrichment), although other factors such as; sediment loads, dissolved oxygen and temperature, can influence this index. The HBI for Little Cottonwood Creek was 3.05 and indicates “Excellent” water quality with no apparent organic pollution (Hilsenhoff 1987).

The United States Forest Service (USFS) Community Tolerance Quotient (CTQ) is a common metric used by the USFS and Bureau of Land Management (BLM) throughout the western United States. According to the National Aquatic Monitoring Center (aka. Utah State Bug Lab) aquatic invertebrate report 2010.

“Taxa are assigned a tolerant quotient (TQ) from 2 taxa found only in high quality unpolluted water, to 108 taxa found in severely polluted waters. TQ values were developed by Winget and Mangum (1979). The dominance weighted community tolerance quotient (CTQd) was calculated. Values can vary from about 20 to 100, in general the lower the value the better the water quality.”

Little Cottonwood Creek’s CTQ(d) is 55 and indicates relatively good water quality.

Benthic macroinvertebrates collected by Falter and Freitag (1996) indicated that the Little Cottonwood Creek benthic community was dominated by Dipterans (64.7 %). In contrast, only 8.12% of our sample consisted of Dipterans, and the sample was dominated by Ephemeropterans (66%) (Figure 11).

In summary, two robust macroinvertebrate indices (HBI and CTQ), and metrics found in Table 2/Appendix H, indicate relatively unimpaired water quality in Little Cottonwood Creek. Despite historic mining activities adjacent to the creek, the macroinvertebrate assemblage appears to be in good condition (Figures 11 and 12, Appendix I).

Table 2. Vital sign summary table for benthic macroinvertebrates in Little Cottonwood Creek, 2010. Sample reach 001.

Measure	Current Condition
Abundance/Dominance Measures	
Total abundance	494
EPT abundance	414
% Contribution dominant family (Baetidae)	44.13
Diversity Indices	
Total genera richness	26
Total family richness	20
EPT taxa richness	25
Shannon diversity index	2.620
Evenness	0.710
Biotic Indices	
Hilsenhoff Biotic Index (HBI)	3.05
USFS Community Tolerance Quotient	55.0
Functional Feeding Group Composition	
% Shredders	10
% Scrapers	20
% Collector-filterers	3
%Collector-gatherers	30
% Predators	25
% Unknown	13

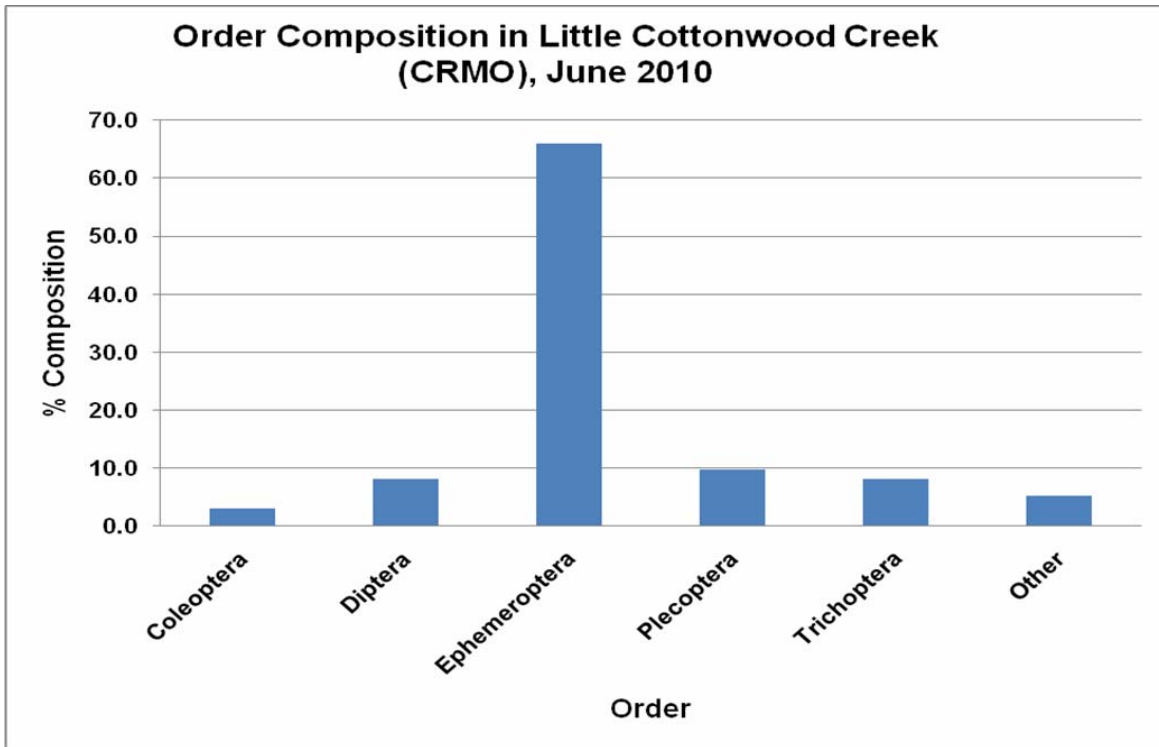


Figure 11. Percent order composition in Little Cottonwood Creek, June 2010. Note that the “Other” category consists of organisms only identified to Class (i.e. Phylum Annelida)

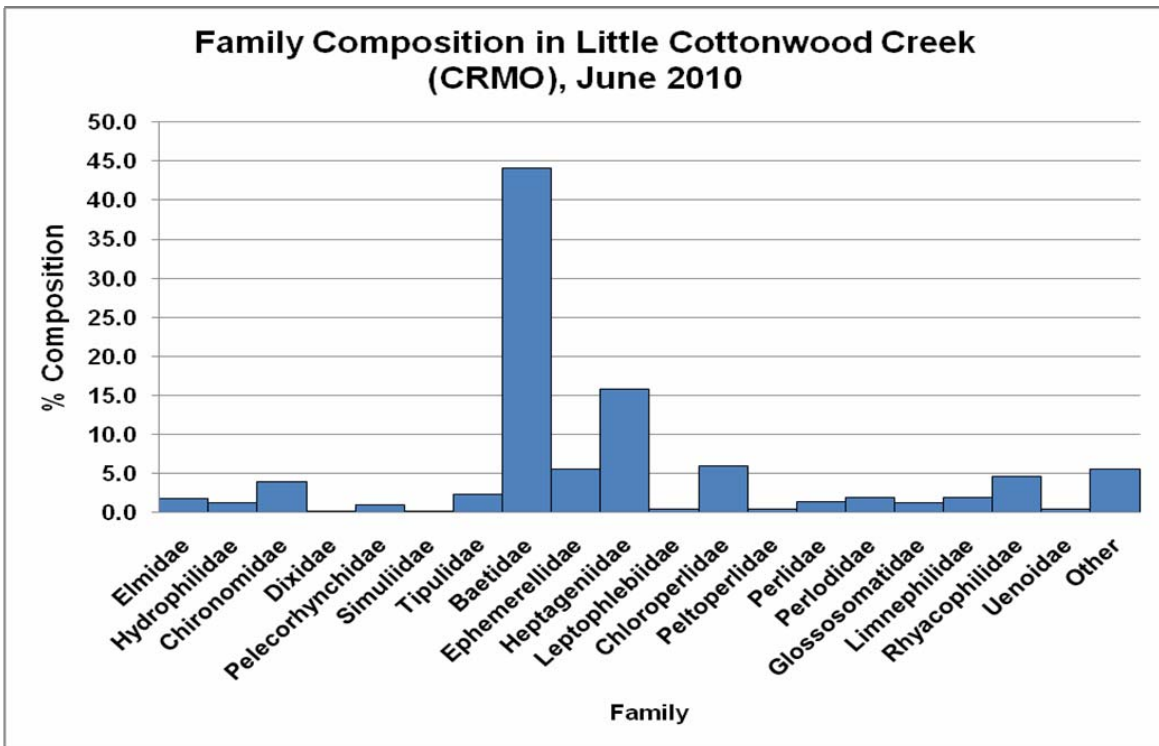


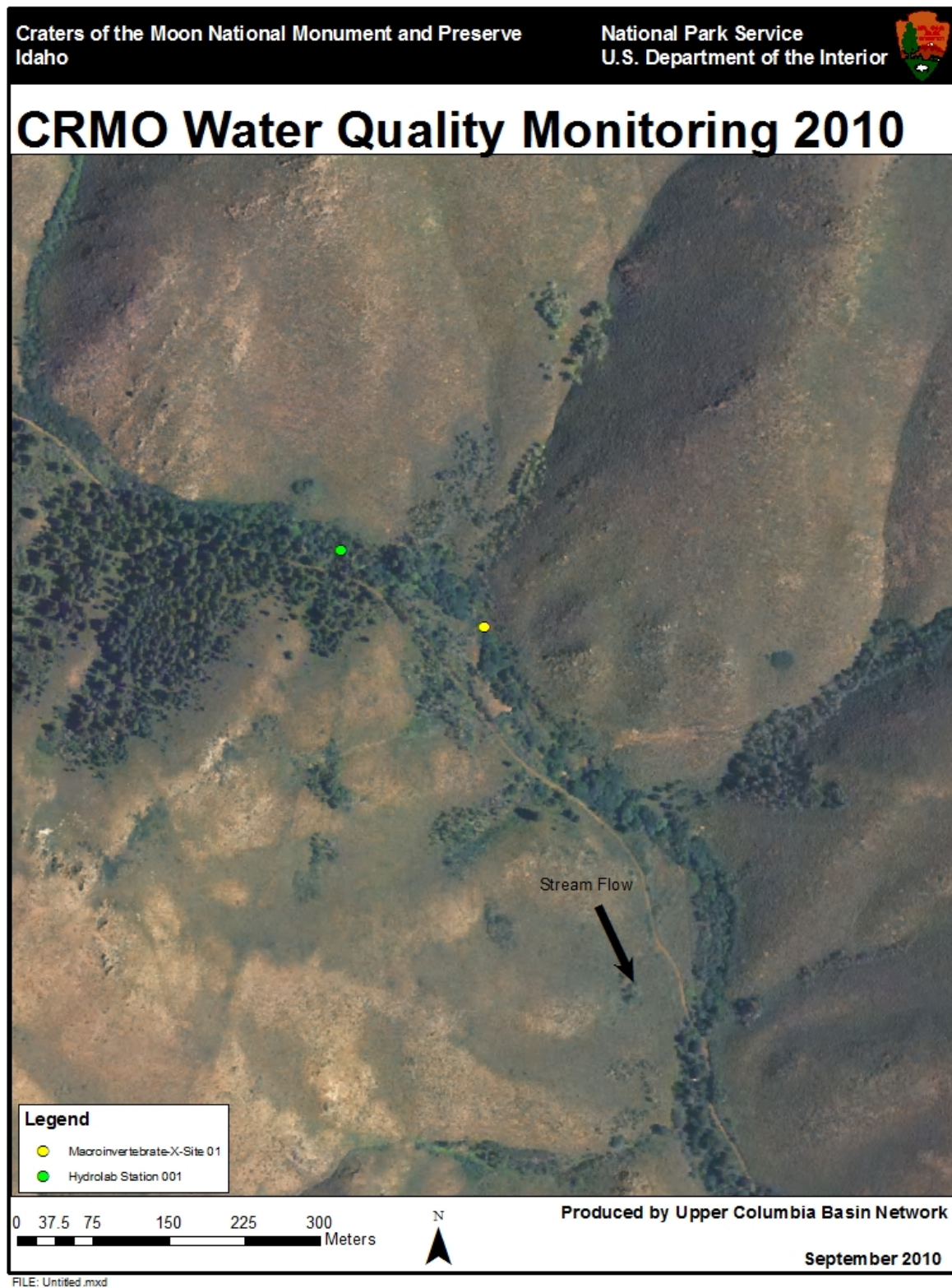
Figure 12. Percent family composition in Little Cottonwood Creek, June 2010. Note that the “Other” category consists of organisms only identified to Class (i.e. Phylum Annelida)

Literature Cited

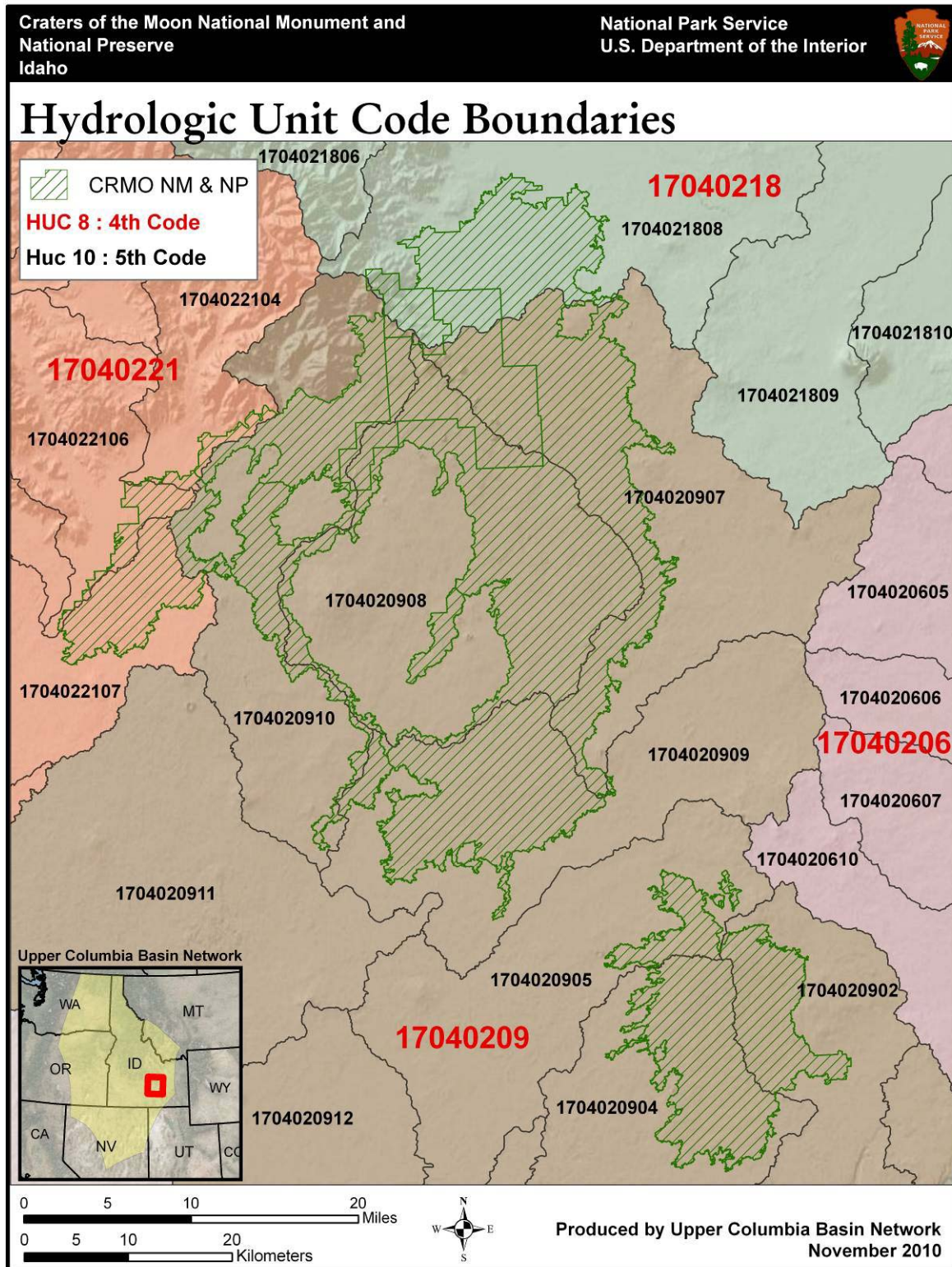
- Barbour, M. T., J. Gerritsen, B. D. Snyder, and J. B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency.
- Bell, J., D. Cogan, J. Erixson, and J. Von Loh. 2009. Vegetation inventory project report, Craters of the Moon National Monument and Preserve. Natural Resource Technical Report NPS/UCBN/NRTR—2009/277. National Park Service, Fort Collins, CO.
- Falter, C. M., R. J. Freitag. 1996. Baseline study of water resources on Craters of the Moon National Monument, Idaho. Natural Resources Technical Report NPS/CCSOUI/NRTR-96/06. National Park Service, Seattle WA.
- Garrett, L. K., T. J. Rodhouse, G. H. Dicus, C. C. Caudill, and M. R. Shardlow. 2007. Vitals Signs Monitoring Plan, Upper Columbia Basin Network. Natural Resource Report NPS/PWR/UCBN/NRR—2007/002. National Park Service, Fort Collins, CO.
- Hilsenhoff, W. L. 1987. An improved biotic index of organic stream pollution. *Great Lakes Entomologist* 20:31-39.
- Idaho Administrative Code. 2010. Idaho administrative code-Department of Environmental Quality, IDAPA 58.01.02 water quality standards. Idaho Department of Environmental Quality, Boise, ID. <http://adm.idaho.gov/adminrules/rules/idapa58/58index.htm>. Accessed 3 March 2011.
- Irwin, R. J. 2008. Draft Part B lite QA/QC review checklist for aquatic vital sign monitoring protocols and SOPs, National Park Service, Water Resources Division. Fort Collins, CO. (http://www.nature.nps.gov/water/Vital_Signs_Guidance/Guidance_Documents/PartBLite.pdf). Accessed 18 February 2010.
- National Aquatic Monitoring Center. 2010. Aquatic invertebrate report for samples collected by Upper Columbia Basin Network. National Aquatic Monitoring Center, Logan, UT.
- National Park Service (NPS), David Louter. 1995. Historic Context Statements: Craters of the Moon National Monument, Idaho. . US Department of the Interior National Park Service. Seattle, WA. (http://www.nps.gov/history/history/online_books/crmo/hcs/index.htm) Accessed 16 November 2010.
- National Park Service (NPS) 1998. Baseline water quality data inventory and analysis: Craters of the Moon National Monument. NPS/NRWRD/NRTR-98/178. US Department of the Interior National Park Service, Fort Collins, CO.

- National Park Service (NPS). 1999. Natural resource challenge: the National Park Service's action plan for preserving natural resources. US Department of the Interior National Park Service, Washington D.C.
(<http://www.nature.nps.gov/challenge/challengedoc/index.htm>). Accessed 18 February 2010.
- National Park Service (NPS). 2000. Strategic plan FY 2001-2005. NPS D-1383. US Department of the Interior National Park Service, Washington D.C.
(http://planning.nps.gov/document/NPS_strategic_plan.pdf). Accessed 3 March 2011.
- Peck, D. V., A. T. Herlihy, B. H. Hill, R. M. Hughes, P. R. Kaufmann, D. Klemm, J. M. Lazorchak, F. H. McCormick, S. A. Peterson, P. L. Ringold, T. Magee, and M. Cappaert. 2006. Environmental Monitoring and Assessment Program-Surface Waters Western Pilot Study: Field Operations Manual for Wadeable Streams. EPA/620/R-06/003. U.S. Environmental Protection Agency, Washington, DC.
- Starkey, E. N., L. K. Garrett, T. J. Rodhouse, G. H. Dicus, and R. K. Steinhorst. 2008. Upper Columbia Basin Network integrated water quality monitoring protocol: Narrative version 1.0. Natural Resource Report NPS/UCBN/NRR—2008/026. National Park Service, Fort Collins, CO. (http://science.nature.nps.gov/im/units/ucbn/reports/index.cfm#IWQ_Mon). Accessed 18 February 2010.
- United States EPA. 2001. Environmental Monitoring and Assessment Program (EMAP): National Coastal Assessment Quality Assurance Project Plan 2001-2004. United States Environmental Protection Agency, Office of Research and Development, National Health and Environmental Effects Research Laboratory, Gulf Ecology Division, Gulf Breeze, FL. EPA/620/R-01/002.
- United States EPA. 1995. Environmental Monitoring and Assessment Program (EMAP): Laboratory Methods Manual-Estuaries, Volume 1: Biological and Physical Analyses. U.S. Environmental Protection Agency, Office of Research and Development , Narragansett, RI. EPA/620/R-95/008.
- United States Geological Survey (USGS), and United States Natural Resources Conservation Service (NRCS). 2009. Federal guidelines, requirements, and procedures for the national Watershed Boundary Dataset: U.S. Geological Survey Techniques and Methods. 11-A3, 55.
- Wagner, R. J., R. W. Boulger Jr., C. J. Oblinger, and B. A. Smith. 2006. Guidelines and Standard procedures for continuous water-quality monitors: station operation, record computation, and data reporting: U.S. Geological Survey Techniques and Methods 1-D3, 51.
- Winget, R.N. and Magnum, F.A. 1979. Biotic Condition Index: Integrated Biological, Physical, and Chemical Stream Parameters for Management. Intermountain Region, U.S. Department of Agriculture, Forest Service, Ogden, UT.

Appendix A. 2010 Water Quality Monitoring Locations in CRMO



Appendix B. CRMO Hydrologic Unit Code Boundaries



Appendix C. Sample Locations for Water Quality Monitoring at CRMO

Park	Stream	Monitoring Type	Macroinvertebrate Site ID/Water Chem. Station ID	Lat.	Long.	Y	X
CRMO	Little Cottonwood Creek	Macroinvertebrate	001	43.48729061	-113.59169737	4820574.12107165	775609.55436206
CRMO	Little Cottonwood Creek	Water Chemistry	001	43.48793970	-113.59347828	4820640.31306458	775462.58067824

Note that X and Y have been projected in NAD 83, UTM Zone 12. These locations were recorded by the field crew with a handheld GPS unit.

Appendix D. 2010 Water Quality Photo Point Locations at CRMO

Park	Stream	Macroinvertebrate Site ID	Transect	Distance from Left Bank Permanent Marker
CRMO	Little Cottonwood Creek	001	F	0.68 m

Photos were taken facing upstream, downstream, and of the left and right banks.

CRMO_LCottonwood_001_UP_20100622



CRMO_LCottonwood_001_Down_20100622



CRMO_LCottonwood_001_Left_20100622



CRMO_LCottonwood_001_Right_20100622



Appendix E. Quality Control (QC) Indicators

QC data quality indicators for 2010 season at CRMO, Little Cottonwood Creek, Hydrolab 064, Station #CRMO 001.

STORET Name	Units	Detection Range Description from Manufacture	Method Detection Limit (MDL)	Minimum Level of Quantitation (ML)	Alternative Measurement Sensitivity Plus (AMS+) Beginning of Season	Alternative Measurement Sensitivity Plus (AMS+) End of Season	Precision+ (RPD) Beginning of Season	Precision+ (RPD) End of Season
Temperature, water	deg C	-5 to 50°C	N/A	N/A	0.05	0.11	0.05	0.11
Specific Conductance	µS/cm	0 to 100,000 µS/cm	N/A	N/A	1.5	0.9	0.35	0.15
Dissolved Oxygen	mg/L	0-20 mg/L	N/A	N/A	0.05	0.07	.10	0.10
pH	pH units	0-14 Units	N/A	N/A	0.06	0.05	0.12	0.00
Turbidity	NTU	0-3000 NTU	0.2	0.78	N/A	N/A	1.85	7.59

Appendix F. Corrections History

Correction history for Little Cottonwood Creek, CRMO 2010 turbidity data.			
Correction #	From	To	Comment
1	6/22/2010	6/22/2010	Delete Region due to outlier
	11:25	11:36	
2	6/23/2010	6/23/2010	Delete Region due to outlier
	13:19	13:38	

Appendix G. Summary Information for Each Macroinvertebrate Sample Reach

Park	Stream	Site	Date	Mean Wetted Width (m)	Sample Reach Length	Total transects sampled	% of sample taken in each substrate category:				% of sample taken in each channel type:			
							Fine	Gravel	Coarse	Boulder	Pool	Glide	Riffle	Rapid
CRMO	Little Cottonwood Creek	001	06/22/2010	0.58	150	11	36.4	45.5	18.2	0.0	9.1	0.0	63.6	27.3

Appendix H. Macroinvertebrate Metrics

As provided by National Aquatic Monitoring Center 2010.

SampleID	143619
Station	CRMO-LC-01
Stream	Little Cottonwood Creek
County	Butte
State	ID
Latitude	43.48725
Longitude	-113.591699
Elevation(m)	1829.268293
Collection Date	6/22/2010
Habitat Sampled	Multiple
Collection Method	D-Frame Kicknet
Field Notes	--
Lab Notes	--
Area sampled(m^2)	1.022
Field Split	100
Lab Split	100
# of SubSampled Organisms	505
Richness	40
Abundance	494
Shannon's Diversity	2.62
Simpson's Diversity	0.14
Evenness	0.71
# of Families	20
Abundance of Dominant Families	218
Abundance of Dominant Taxa	157
# of Genera Identified	26
# of EPT Taxa	25
EPT Taxa Abundance	414
# of Intolerant Taxa (HBI = 0, 1, or 2)	13
# of Tolerant Taxa (HBI = 8, 9, or 10)	0
Intolerant Taxa abundance (HBI = 0, 1, or 2)	104
Tolerant Taxa abundance (HBI = 8, 9, or 10)	0
Hilsenhoff Biotic Index	3.05
# of clinger taxa	15
Long-lived Taxa	5
Elmidae abundance	9
USFS Community Tolerance Quotient (d)	55
# of shredder taxa	4
Shredder Abundance	19

Appendix H. Macroinvertebrate Metrics (continued)

# of scraper taxa	8
Scraper abundance	96
# of collector-filterer taxa	1
Collector-filterer abundance	1
# of collector-gatherer taxa	12
Collector-gatherer abundance	287
# of predator taxa	10
Predator abundance	76
# of Ephemeroptera taxa	10
Ephemeroptera abundance	326
# of Plecoptera taxa	8
Plecoptera abundance	48
# of Trichoptera taxa	7
Trichoptera abundance	40
# of Coleoptera taxa	3
Coleoptera abundance	15
# of Megaloptera taxa	0
Megaloptera abundance	0
# of Diptera taxa	11
Diptera abundance	40
# of Chironomidae taxa	4
Chironomidae abundance	20
# of Crustacea taxa	0
Crustacea abundance	0
# of Oligochaete taxa	1
Oligochaete abundance	25
# of Mollusca taxa	0
Mollusca abundance	0
# of other taxa	0
Other abundance	0
# of Insect taxa	39
Insect abundance	469
# of non-insect taxa	1
Non-insect abundance	25

Appendix I. Macroinvertebrate Taxa List *As provided by National Aquatic Monitoring Center 2010.*

Taxa by sample abundances

Abundance data is the estimated number per square meter for quantitative samples

Abundance data is the estimated number per sample for qualitative samples

SampleID	143619	Habitat	Multiple
Station	CRMO-LC-01	Method	D-Frame Kicknet
Stream	Little Cottonwood Creek	Fieldnotes	None
County	Butte	LabNotes	None
State	ID	Area	1.022
Lat	43.48725	Fieldsplit	100
Long	-113.591699	Labsplit	100
Elevation	1829.268293	Count	505
Sampdate	6/22/2010		

41

Code	Phylum	Class	Order	Family	SubFamily	Genus	Species	Count
19	Annelida	Clitellata						25
129	Arthropoda	Insecta	Coleoptera	Elmidae		<i>Heterlimnius</i>	<i>corpulentus</i>	9
158	Arthropoda	Insecta	Coleoptera	Hydrophilidae	Hydrophilinae	<i>Enochrus</i>		4
154	Arthropoda	Insecta	Coleoptera	Hydrophilidae		<i>Ametor</i>		2
182	Arthropoda	Insecta	Diptera	Chironomidae	Chironominae			1
184	Arthropoda	Insecta	Diptera	Chironomidae	Orthoclaadiinae			17
187	Arthropoda	Insecta	Diptera	Chironomidae	Tanypodinae			1
180	Arthropoda	Insecta	Diptera	Chironomidae				1
198	Arthropoda	Insecta	Diptera	Dixidae		<i>Dixa</i>		1
213	Arthropoda	Insecta	Diptera	Pelecorhynchidae		<i>Glutops</i>		5
223	Arthropoda	Insecta	Diptera	Simuliidae	Simuliinae	<i>Simulium</i>		1
247	Arthropoda	Insecta	Diptera	Tipulidae	Tipulinae	<i>Tipula</i>		7
237	Arthropoda	Insecta	Diptera	Tipulidae		<i>Dicranota</i>		1
241	Arthropoda	Insecta	Diptera	Tipulidae		<i>Hexatoma</i>		4
173	Arthropoda	Insecta	Diptera					2
250	Arthropoda	Insecta	Ephemeroptera	Baetidae		<i>Baetis</i>		157

Appendix I. Macroinvertebrate Taxa List (continued)

Code	Phylum	Class	Order	Family	SubFamily	Genus	Species	Count
834	Arthropoda	Insecta	Ephemeroptera	Baetidae		<i>Dipheter</i>	<i>hageni</i>	59
249	Arthropoda	Insecta	Ephemeroptera	Baetidae				3
1180	Arthropoda	Insecta	Ephemeroptera	Ephemerellidae		<i>Drunella</i>	<i>coloradensis/flavilinea</i>	11
2066	Arthropoda	Insecta	Ephemeroptera	Ephemerellidae		<i>Ephemerella</i>	<i>inermis/dorothea</i>	17
278	Arthropoda	Insecta	Ephemeroptera	Heptageniidae		<i>Cinygma</i>		8
279	Arthropoda	Insecta	Ephemeroptera	Heptageniidae		<i>Cinygmula</i>		62
280	Arthropoda	Insecta	Ephemeroptera	Heptageniidae		<i>Epeorus</i>		1
276	Arthropoda	Insecta	Ephemeroptera	Heptageniidae				8
287	Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae				2
418	Arthropoda	Insecta	Plecoptera	Chloroperlidae	Chloroperlinae	<i>Suwallia</i>		7
416	Arthropoda	Insecta	Plecoptera	Chloroperlidae		<i>Paraperla</i>		1
688	Arthropoda	Insecta	Plecoptera	Chloroperlidae		<i>Plumiperla</i>		1
412	Arthropoda	Insecta	Plecoptera	Chloroperlidae				21
443	Arthropoda	Insecta	Plecoptera	Peltoperlidae		<i>Yoraperla</i>		2
1270	Arthropoda	Insecta	Plecoptera	Perlidae		<i>Doroneuria</i>	<i>theodora</i>	3
444	Arthropoda	Insecta	Plecoptera	Perlidae				4
462	Arthropoda	Insecta	Plecoptera	Perlodidae	Isoperlinae	<i>Isoperla</i>		10
489	Arthropoda	Insecta	Trichoptera	Glossosomatidae		<i>Anagapetus</i>		4
487	Arthropoda	Insecta	Trichoptera	Glossosomatidae				2
1481	Arthropoda	Insecta	Trichoptera	Limnephilidae		<i>Chyrandra</i>	<i>centralis</i>	7
528	Arthropoda	Insecta	Trichoptera	Limnephilidae				3
1206	Arthropoda	Insecta	Trichoptera	Rhyacophilidae		<i>Rhyacophila</i>	<i>brunnea/vemna group</i>	23
549	Arthropoda	Insecta	Trichoptera	Uenoidae	Thremmatinae	<i>Neophylax</i>		1
588	Arthropoda	Insecta	Trichoptera	Uenoidae				1

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 131/107040, March 2011

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