



Upper Columbia Basin Network Integrated Water Quality Annual Report 2013

Craters of the Moon National Monument and Preserve (CRMO)

Natural Resource Technical Report NPS/UCBN/NRTR—2014/903



ON THE COVER

Little Cottonwood Creek, 22 June 2013 Craters of the Moon National Monument and Preserve
NPS Photo

Upper Columbia Basin Network Integrated Water Quality Annual Report 2013

Craters of the Moon National Monument and Preserve (CRMO)

Natural Resource Technical Report NPS/UCBN/NRTR—2014/903

Eric Starkey

National Park Service
Upper Columbia Basin Network Inventory and Monitoring Program
105 E. 2nd St.
Suite #7
Moscow, ID 83843

August 2014

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Technical Report Series is used to disseminate results of scientific studies in the physical, biological, and social sciences for both the advancement of science and the achievement of the National Park Service mission. The series provides contributors with a forum for displaying comprehensive data that are often deleted from journals because of page limitations.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner. Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available in digital format from the Upper Columbia Basin Network website (<http://www.nature.nps.gov/im/units/ucbn/>) and the Natural Resource Publications Management website (<http://www.nature.nps.gov/publications/nrpn/>). To receive this report in a format optimized for screen readers, please email irma@nps.gov.

Please cite this publication as:

Starkey, E. N. 2014. Upper Columbia Basin Network integrated water quality annual report 2013: Craters of the Moon National Monument and Preserve (CRMO). Natural Resource Technical Report NPS/UCBN/NRTR—2014/903. National Park Service, Fort Collins, Colorado.

Contents

	Page
Figures.....	v
Tables.....	vii
Appendices.....	ix
Executive Summary	xi
Acknowledgments.....	xiii
Introduction and Background	1
Objectives	2
Study Area	3
Little Cottonwood Creek – Craters of the Moon National Monument and Preserve (CRMO).....	3
Monitoring Sites	5
Methods.....	11
Water Chemistry.....	11
Cross Section Survey.....	11
Quality Assurance/Quality Control (QA/QC):	11
Macoinvertebrates	12
Results and Discussion	13
Water Chemistry.....	13
Status	13
Macroinvertebrates.....	19
Status	19
Literature Cited	21

Figures

	Page
Figure 1. Craters of the Moon National Monument (NPS 1998).....	6
Figure 2. Water quality monitoring locations in Little Cottonwood Creek 2013.	7
Figure 3. Little Cottonwood Creek drainage, looking downstream towards the highway and visitor center.	8
Figure 4. Little Cottonwood Creek and riparian vegetation. Wetted width is approximately 1 m.	8
Figure 5. Little Cottonwood Creek, looking upstream, June 2008.	9
Figure 6. Water temperature in Little Cottonwood Creek, 21-22 June 2013.....	14
Figure 7. Daily maximum water temperature in Little Cottonwood Creek, June-October 2013.....	14
Figure 8. Specific conductance in Little Cottonwood Creek, CRMO, June 2013.	15
Figure 9. Dissolved oxygen and temperature in Little Cottonwood Creek, CRMO, June 2013.....	16
Figure 10. Corrected pH in Little Cottonwood Creek, CRMO, June 2013.....	17
Figure 11. Corrected turbidity in Little Cottonwood Creek, CRMO, June 2013.....	18

Tables

	Page
Table 1. Vital sign summary table for water chemistry in Little Cottonwood Creek June, 2013 and 2010.....	13
Table 2. Vital sign summary table for benthic macroinvertebrates in Little Cottonwood Creek, 2013. For comparison 2008 metrics are also listed.	19

Appendices

	Page
Appendix A. 2013 Water Quality Monitoring Locations	25
Appendix B. CRMO Hydrologic Unit Code Boundaries	27
Appendix C. Sample Locations for Water Quality Monitoring at CRMO	29
Appendix D. Quality Control (QC) Indicators.....	31
Appendix E. Corrections History.....	33
Appendix F. Macroinvertebrate Metrics.....	35
Appendix G. Standardized Species Matrix.....	39

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) is comprised of 9 national park sites located in Idaho, Montana, Oregon, and Washington.

The UCBN has identified 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. 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.

This annual report details the status of key indicators of water quality obtained from monitoring in Craters of the Moon National Monument and Preserve (CRMO), June 21-22, 2013. Little Cottonwood Creek was previously sampled by the UCBN in 2010 (see Starkey 2011). Data from the 2013 field sampling effort was collected following methods detailed in the UCBN integrated water quality monitoring protocol (Starkey et al. 2008, Starkey et al. 2013). 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/publications.cfm?tab=3>. Benthic macroinvertebrates were collected according to a protocol established by the United States Forest Service- PACFISH/INFISH Biological Opinion (PIBO) program. These methods are also outlined in the UCBN monitoring protocol for stream channel characteristics (Starkey et al. 2011), which can also be found on the UCBN’s website listed above.

Water chemistry and macroinvertebrate results indicate that 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 is given in the summary table on the following page. UCBN water quality monitoring is conducted on a 3 year rotating panel. Therefore, conditions in Little Cottonwood Creek will be re-evaluated in 2016.

Note that several of the appendices in this report are primarily intended for UCBN internal reference. In addition, some appendices represent hard copy data forms used in quality assurance/quality control procedures performed during data processing.

Little Cottonwood Creek Water Chemistry Summary 2013

Measure	Current Condition (June 21-22, 2013)	NPS Baseline Data 1998 (Site CRMO0021 Upper Little Cottonwood)	State DEQ Thresholds ^a	% Exceedance ^b
Temperature (*MDMT, **MDAT)	*MDMT= 9.07 °C ** MDAT= 8.29 °C	mean = 9.13 °C max. = 15.0 °C	*MDMT<22 °C **MDAT<19 °C	0%
				0%
Specific conductance (mean)	250.89 µS/cm	mean = 160.86 µS/cm max. 228 µS/cm	N/A	N/A
Dissolved oxygen (mean daily min)	8.94 mg/L	mean = 7.92 mg/L min = 5.4 mg/L	> 6.0 mg/L	0%
pH (mean daily max)	8.32 pH Units	max. = 8.0 pH Units	9.0 pH Units, Max	0%
pH (mean daily min)	8.28 pH Units	min = 6.2 pH Units	6.5 pH Units, Min	0%
Turbidity (mean daily max)	8.0 NTU	max. 3.4 NTU	< 50 NTU over background (instantaneous) < 25 for 10 consecutive days	Insufficient data

*MDMT – Maximum Daily Maximum Temperature, **MDAT – Maximum Daily Average Temperature, ^aCriteria for cold water life designation ^b Proportion of 2013 samples above water quality standard

ix:

0-5% exceedance	
5-25% exceedance	
>25% exceedance	

Acknowledgments

Funding for this project was provided through the National Park Service Natural Resource Challenge and the Servicewide Inventory and Monitoring Program. The UCBN would also like to thank CRMO staff for their assistance in the field, accommodations during field work, and for the review of this report.

Introduction and Background

Water resources have been identified as a high priority vital sign for the Upper Columbia Basin Network (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 UCBN to accomplish water quality monitoring. In June 2013 the UCBN began its second year of integrated water quality monitoring in 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 are addressed in separate monitoring protocols which have not been implemented at CRMO due to Little Cottonwood Creek's constrained valley bottom and steep gradient.

The objectives of the UCBN Integrated Water Quality Monitoring Protocol are to document the aquatic macroinvertebrate assemblage composition and baseline water chemistry parameters. 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 (Ia4) that streams and rivers managed by NPS will meet State and Federal water quality standards (NPS 2000).

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 Total Maximum Daily Loads (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 the Environmental Protection Agency (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 (Appendix A and B). 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. It is important to note that as of the 2012 integrated water quality report (ID DEQ 2013^a) Little Cottonwood Creek was still listed in the Lake Walcott subbasin, because it is part of an assessment unit (Copper Creek) that was split into separate HUCs (Big Lost and Lake Walcott) when the HUC boundary was changed in 2009.

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 2013 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 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).

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 identified in the 2012 Idaho Department of Environmental Quality integrated water quality report and Idaho administrative code, Little Cottonwood Creek is part of the Copper Creek assessment unit (ID DEQ 2013a, ID DEQ 2013b, ID Admin Code 2013, 58.01.02.150.11 [through 4/5/00]). This assessment unit has the following beneficial uses: cold water aquatic life, salmonid spawning, and secondary contact recreation (ID DEQ 2013b). This assessment unit is listed as not supporting the beneficial use of cold water aquatic life and is considered a category 5 water. Category 5 waters are polluted waters requiring that a total maximum daily load be developed and implemented. While currently listed as impaired, due to being part of the Copper Creek assessment unit, it is important to note that Little Cottonwood Creek is an isolated stream and has no surface water connection to other streams in this unit.

Monitoring Sites

Water Chemistry

The water chemistry monitoring site was approximately 800 m downstream of the headwaters in a shallow pool. The continuous water quality sonde (Hydrolab MS-5) was deployed 580 meters upstream from where the 2-track road crosses the creek (Figure 2 and Appendix C). 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 of the headwaters. The center of the macroinvertebrate sample reach 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.

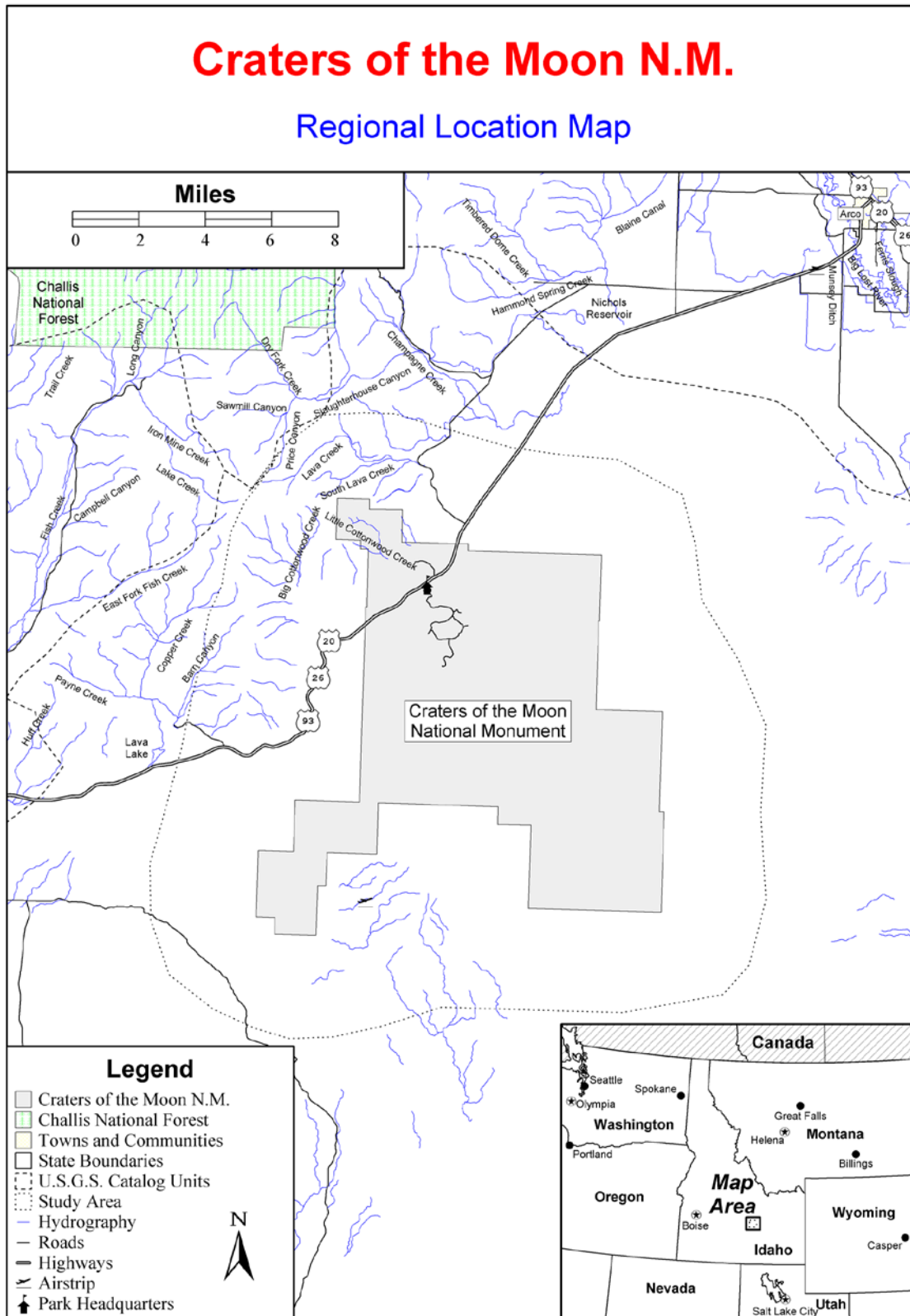


Figure 1. Craters of the Moon National Monument (NPS 1998). Note that this map does not include the expanded preserve (to the South West) created in 2000.



CRMO Water Quality Monitoring 2013

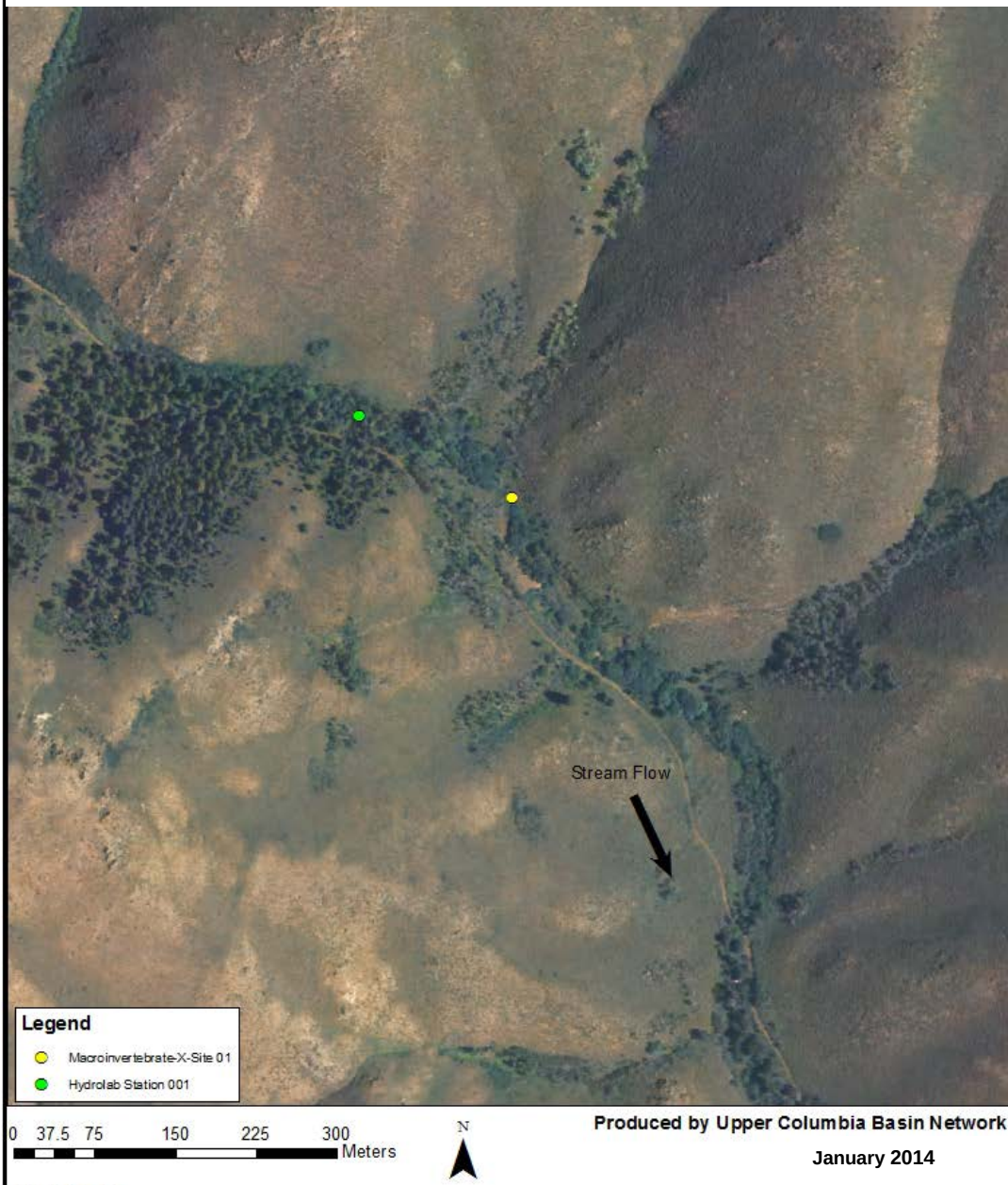


Figure 2. Water quality monitoring locations in Little Cottonwood Creek 2013. Note the 2-track road that runs parallel to and crosses the stream.



Figure 3. Little Cottonwood Creek drainage, looking downstream towards the highway and visitor center. Note that the end of 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. Stream flow conditions were similar in 2013, with no surface flow existing downstream of the cottonwood trees seen in the background.

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 and 2013).

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 continuous water quality monitor data collection are covered in detail in SOP #12 (Starkey et al. 2013). 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. 2008 and Appendix D 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, Starkey et al. 2013.

Macoinvertebrates

Macroinvertebrates were collected at a single sample reach (established in 2010) using the United States Forest Service- PACFISH/INFISH Biological Opinion (PIBO) Effectiveness Monitoring Program's protocol. Macroinvertebrates were collected from 8 fast water habitats (riffles, runs) in the sample reach. These 8 samples were combined for a single composite sample. 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 PIBO macroinvertebrate sampling design, see Heitke et al. (2009) and Starkey et al. (2013).

Results and Discussion

Water Chemistry

Status

Condition of core water quality parameters along with the corresponding Idaho DEQ regulatory threshold are given in Table 1. Data indicate that conditions were well within acceptable ranges relative to criteria for cold water aquatic life (ID Admin Code 2013, 58.01.02.150.11 [through 4/5/00]). Individual parameters are discussed below.

Table 1. Vital sign summary table for water chemistry in Little Cottonwood Creek June, 2013 and 2010.

Little Cottonwood Creek Water Chemistry Summary 2010 and 2013				
Measure	Condition (June 21-22, 2013)	Condition (22-23 June, 2010)	State DEQ Thresholds ^a	2013 % Exceedance ^b
Temperature (*MDMT, **MDAT)	*MDMT= 9.07 °C	*MDMT= 10.45 °C	*MDMT<22 °C	0%
	**MDAT= 8.29 °C	**MDAT= 10.45 °C	**MDAT<19 °C	0%
Specific conductance (mean)	250.89 µS/cm	223.97 µS/cm	N/A	N/A
Dissolved oxygen (mean daily min)	8.94 mg/L	8.80 mg/L	> 6.0 mg/L	0%
pH (mean daily max)	8.32 pH Units	8.8 pH Units	9.0 pH Units, Max	0%
pH (mean daily min)	8.28 pH Units	8.56 pH Units	6.5 pH Units, Min	0%
Turbidity (mean daily max)	8.0 NTU	<0.2 NTU	< 50 NTU over background (instantaneous) < 25 for 10 consecutive days	Insufficient data

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

^aCriteria for cold water life designation ^b Proportion of samples above water quality standard

0-5% exceedance	
5-25% exceedance	
>25% exceedance	

Temperature

June 21-22, 2013, the maximum daily maximum temperature (MDMT) was 9.07 °C and the maximum daily average temperature (MDAT) was 8.29 °C (Figure 6). Neither the MDMT nor MDAT exceeded the cold water aquatic life criteria of 22.0 °C and 19.0 °C respectively. Data quality was rated as “excellent” due to lack of sensor drift during the deployment (Wagner et al. 2006; Starkey et al. 2008).

Continuous temperature loggers were deployed at this location June-October 2011, 2012, and 2013. In 2011, the MDMT was 11.81 °C and the MDAT was 10.95 °C. In 2012, the MDMT was 15.46 °C and the MDAT was 13.05 °C. In 2013 the MDMT was 13.11 °C and the MDAT was 12.09 °C (Figure 7). Despite low summer stream flow, these data indicate that neither the MDMT nor MDAT

exceeded the cold water aquatic life criteria of 22.0 °C and 19.0 °C respectively. No fouling or drift corrections were applied to 2011, 2012 or 2013 temperature data.

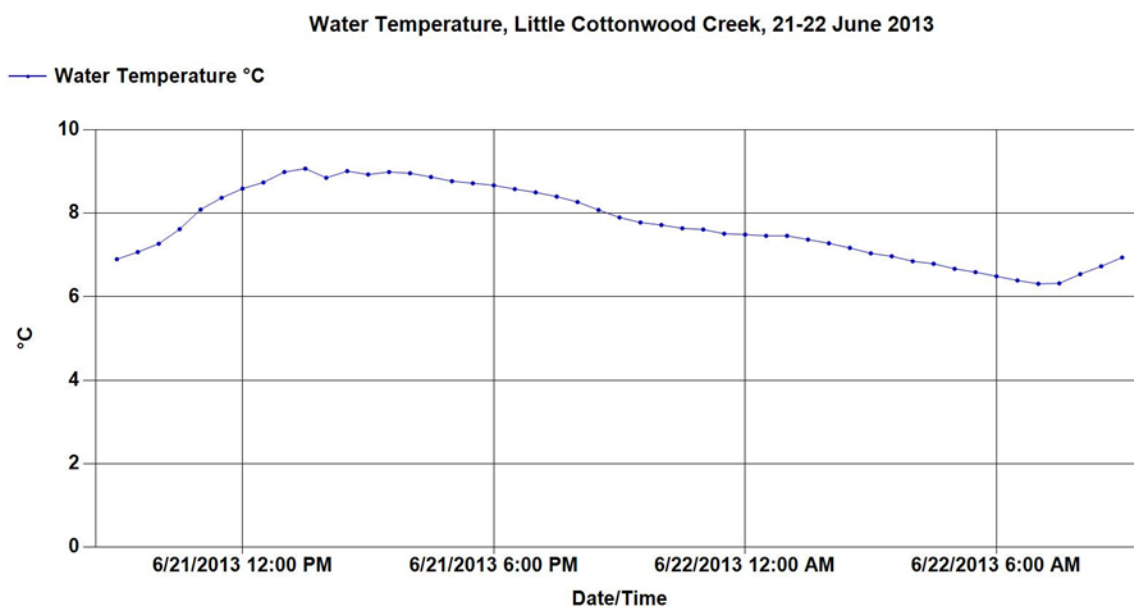


Figure 6. Water temperature in Little Cottonwood Creek, 21-22 June 2013.

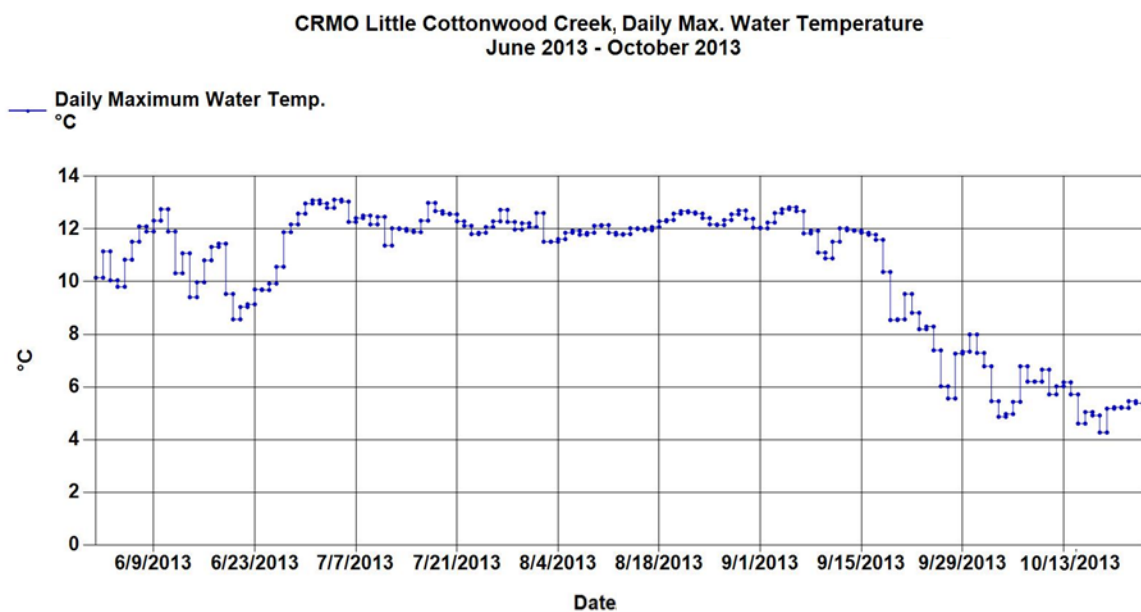


Figure 7. Daily maximum water temperature in Little Cottonwood Creek, June-October 2013.

Specific Conductance

Specific conductance ranged from 250.0 to 252.0 $\mu\text{S}/\text{cm}$, with an average specific conductance of 250.89 $\mu\text{S}/\text{cm}$ (Figure 8). Note that there is no state threshold for specific conductance as it varies widely depending on the geology of the drainage basin and stream discharge. Data quality was rated as “excellent” due to the lack of sensor drift encountered during the deployment (Wagner et al. 2006; Starkey et al. 2008). Corrections that have been applied to the specific conductance data are listed in Appendix E.

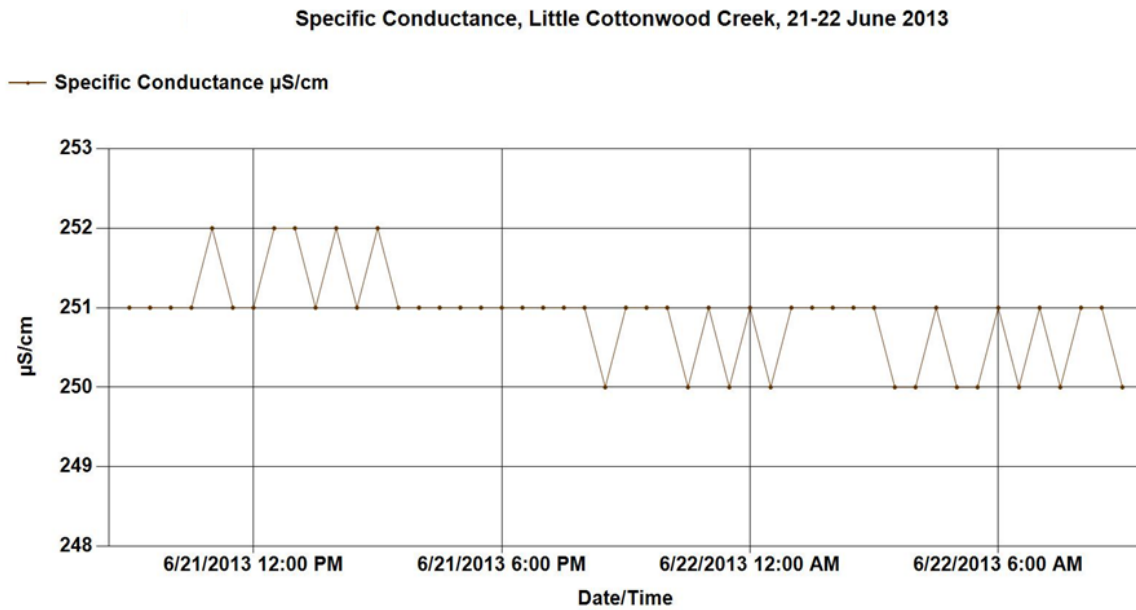


Figure 8. Specific conductance in Little Cottonwood Creek, CRMO, June 2013.

Dissolved Oxygen

Mean daily minimum dissolved oxygen was 8.94 mg/L and was never below the cold water aquatic life criteria of 6.0 mg/L. Minimum dissolved oxygen levels corresponded to maximum water temperatures. Figure 9 shows dissolved oxygen and temperature in Little Cottonwood Creek June 21st and 22nd 2013. Data quality was rated as “excellent” due to the lack of sensor drift encountered during the deployment (Wagner et al. 2006; Starkey et al. 2008). Corrections that have been applied to the dissolved oxygen data are listed in Appendix E.

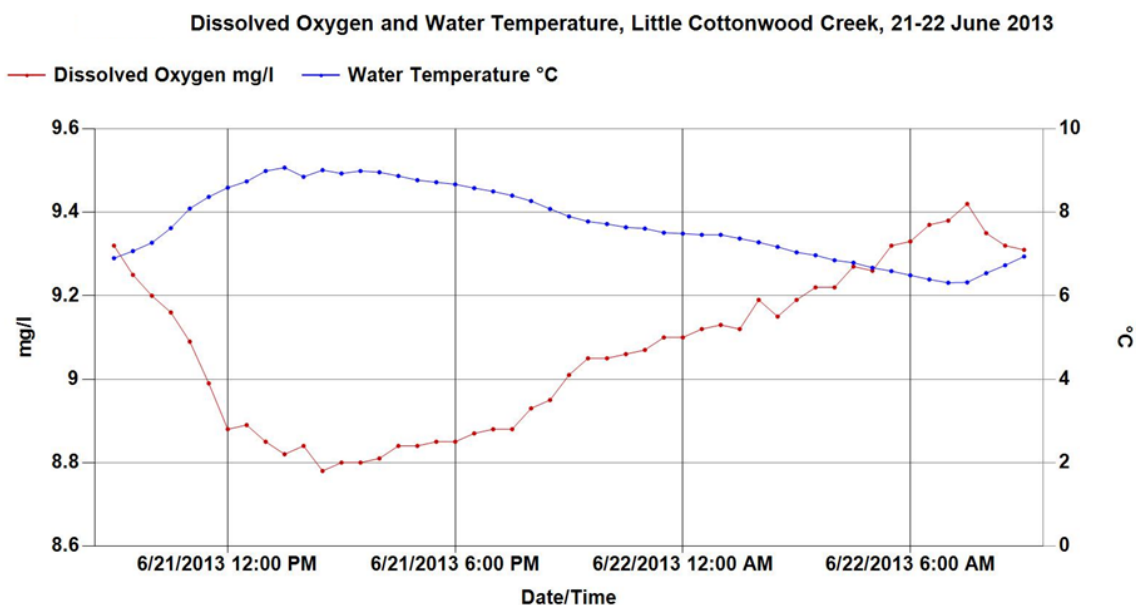


Figure 9. Dissolved oxygen and temperature in Little Cottonwood Creek, CRMO, June 2013.

pH

The minimum and maximum pH (8.28 and 8.32 respectively) were never outside the acceptable cold water aquatic life thresholds of 6.5-9.0 pH units, and the median (8.29 pH units) was well within this range. Figure 10 shows pH levels in Little Cottonwood Creek June 21st and 22nd 2013. Data quality was rated as “excellent” due to the lack of sensor drift encountered during the deployment (Wagner et al. 2006; Starkey et al. 2008). Corrections that have been applied to the pH data are listed in Appendix E.

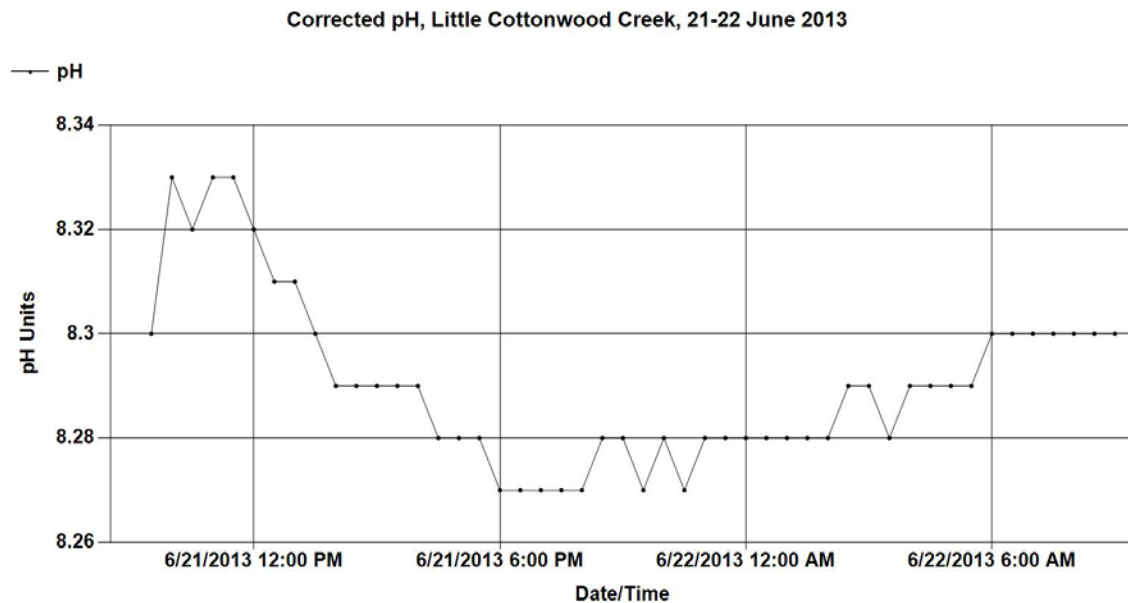


Figure 10. Corrected pH in Little Cottonwood Creek, CRMO, June 2013.
Note that the maximum and minimum regulatory thresholds were never exceeded (6.5, 9.0 pH units).

Turbidity

June 21st and 22nd, the mean daily maximum turbidity was 8.0 NTU and was well under state thresholds for cold water aquatic life (Figure 11). The thresholds states that turbidity should be “< 50 NTU over background (instantaneous) and < 25 NTU for 10 consecutive days. It is important to note that the method detection limit (MDL) for this sensor was 0.2 NTU and the minimum level of quantitation (ML) was 0.49 NTU (Appendix D). Although an outlier was removed, data quality was rated as “good” due to the lack of sensor drift encountered during the deployment (Wagner et al. 2006; Starkey et al. 2008). Corrections that have been applied to the specific conductance data are listed in Appendix E.

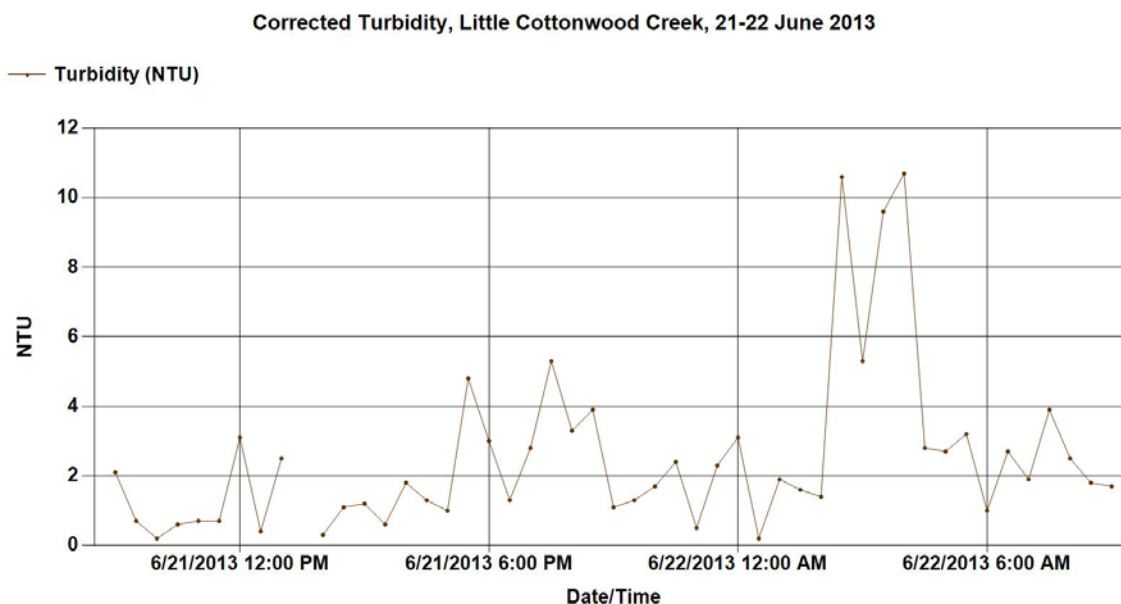


Figure 11. Corrected turbidity in Little Cottonwood Creek, CRMO, June 2013.

Macroinvertebrates

Status

The Hilsenhoff Biotic Index (HBI), which summarizes pollution tolerances of the macroinvertebrate taxa within the sample, was 2.75. This HBI value indicates that water quality is “excellent” with “organic pollution unlikely” (Hilsenhoff 1988). HBI values generally increase (HBI ranges from 0.0 to 10.0) as nutrient enrichment increases. While HBI is most sensitive to organic pollution, it may also respond to sediment loading, low dissolved oxygen and elevated water temperatures. Note that the 2010 HBI was 3.05 and indicated “excellent” water quality and that organic pollution was unlikely. While the HBI indicated similar results in 2010 and 2013 it should be noted that macroinvertebrate sample collection methods and locations differed. The 2010 sample was from pool, riffle, and run habitat (Starkey et al. 2008) following Environmental Protection Agency EMAP protocol and the 2013 sample was from fast water habitat (i.e. riffle/run) following the USFS-PIBO program protocol (Starkey et al. 2013).

In 2013, the US Forest Service (USFS) community tolerance quotient was 55. Community tolerance quotient values vary from 20 to just over 100, with lower values indicating better water quality. In the sample reach, there were 15 Ephemeroptera, Plecoptera, Trichoptera (EPT) taxa which is one more than was recorded in 2010. The number of long lived taxa remained unchanged (4) since 2010. The dominant family was Chloroperlidae (green stoneflies). See Table 2 and Appendix F for additional summary metrics. See Appendix G for a standardized species matrix.

These data and summary metrics suggest that the macroinvertebrate assemblage in Little Cottonwood Creek is in good condition and that water quality is relatively unimpaired.

Table 2. Vital sign summary table for benthic macroinvertebrates in Little Cottonwood Creek, 2013. For comparison 2008 metrics are also listed.

Little Cottonwood Creek Macroinvertebrate Summary		
	21 June 2013	22 June 2010
Sample ID	151067	143619
Richness*	29	24
Shannon's Diversity*	2.57	2.31
Simpson's Diversity*	0.90	0.84
Evenness*	0.76	0.73
# of EPT Taxa*	15	14
Dominant Family	Chloroperlidae	Baetidae
Dominant Taxa	Sweltsa	Baetis
Hilsenhoff Biotic Index*	2.75	3.05
# of Intolerant Taxa*	9	7
# of Tolerant Taxa*	0	0
Tolerant Taxa Abundance	0	0
USFS Community Tolerance Quotient (d)*	55	58
# of shredder taxa*	5	3
# of scraper taxa*	2	5
# of collector-filterer taxa*	1	0
# of collector-gatherer taxa*	9	6
# of predator taxa*	8	8
# of clinger taxa*	7	10
Long-lived Taxa*	4	4

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.
- Heitke, J D., E. K. Archer, and B. B. Roper. 2009. Effectiveness monitoring for streams and riparian areas: sampling protocol for stream channel attributes. PACFISH/INFISH- Biological Opinion Effectiveness Monitoring Program (PIBO-EM). Logan, UT.
<http://www.fs.fed.us/biology/fishecology/emp> (accessed 21 January 2014).
- Hilsenhoff, W. L. 1988. Rapid field assessment of organic pollution with a family-level biotic index. *Journal of the North American Benthological Society*. 7:65-68.
- Idaho Administrative Code. 2013. Idaho administrative code-Department of Environmental Quality, IDAPA 58.01.02 water quality standards. Idaho Department of Environmental Quality, Boise, ID. <http://adminrules.idaho.gov/rules/2013/58/0102.pdf> (accessed 8 January 2014).
- Idaho Department of Environmental Quality (ID DEQ). 2013^a. Idaho Department of Environmental Quality draft 2012 integrated report. ID DEQ. Boise, ID.
http://www.deq.idaho.gov/media/994278-2012_integrated_report_draft.pdf (accessed 8 January 2014).
- Idaho Department of Environmental Quality (ID DEQ). 2013^b. Idaho Department of Environmental Quality draft 2012 integrated report interactive map. ID DEQ. Boise, ID.
<http://mapcase.deq.idaho.gov/wq2012/> (accessed 8 January 2014).
- 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/vitalsigns/assets/docs/PartBLite.pdf> (accessed 21 January 2014).
- 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 21 January 2014).

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/assets/actionplan/NatRes2.pdf> (accessed 21 January 2014).

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 21 January 2014).

Starkey, E. N. 2011. Upper Columbia Basin Network integrated water quality annual report 2010: Craters of the Moon National Monument and Preserve (CRMO). Natural Resource Data Series NPS/UCBN/NRDS—2011/149. National Park Service, Fort Collins, CO. <http://irmafiles.nps.gov/reference/holding/426754> (accessed 21 January 2014).

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://irmafiles.nps.gov/reference/holding/155269> (accessed 21 January 2014).

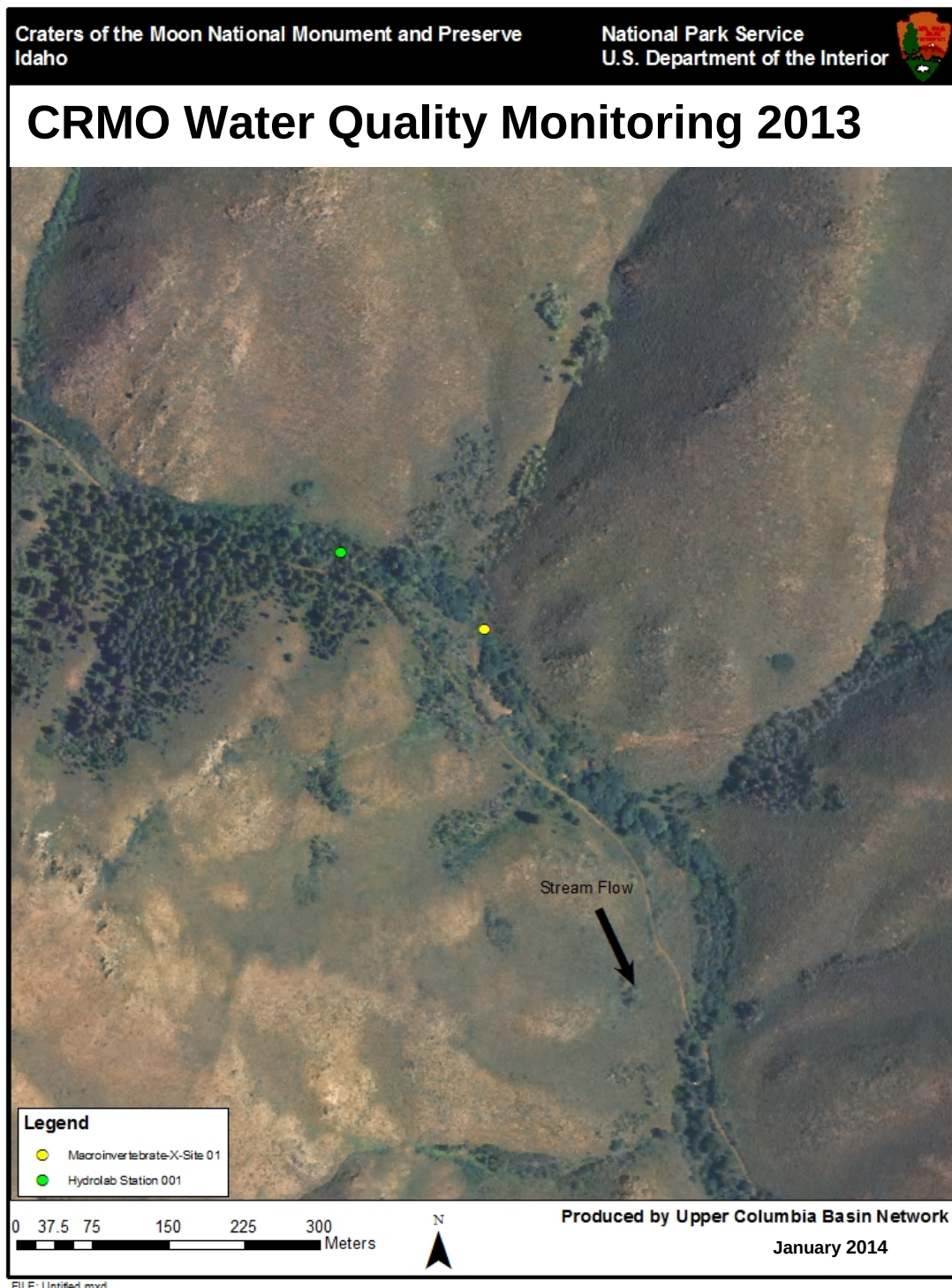
Starkey, E. N., L. K. Garrett, T. J. Rodhouse, G. H. Dicus, and R. K. Steinhorst. 2013. Upper Columbia Basin Network integrated water quality monitoring protocol: standard operating procedures version 1.8. Natural Resource Report NPS/UCBN/NRR—2013/XXX. National Park Service, Fort Collins, CO. <http://irmafiles.nps.gov/reference/holding/466559> (accessed 21 January 2014).

Starkey, E. N., T. J. Rodhouse, G. H. Dicus, L. K. Garrett, K. M. Irvine, and E. K. Archer. 2011. Upper Columbia Basin Network stream channel characteristics monitoring protocol: Narrative version 1.0. Natural Resource Report NPS/UCBN/NRR—2011/340. National Park Service, Fort Collins, CO. <http://irmafiles.nps.gov/reference/holding/427055> (accessed 21 January 2014).

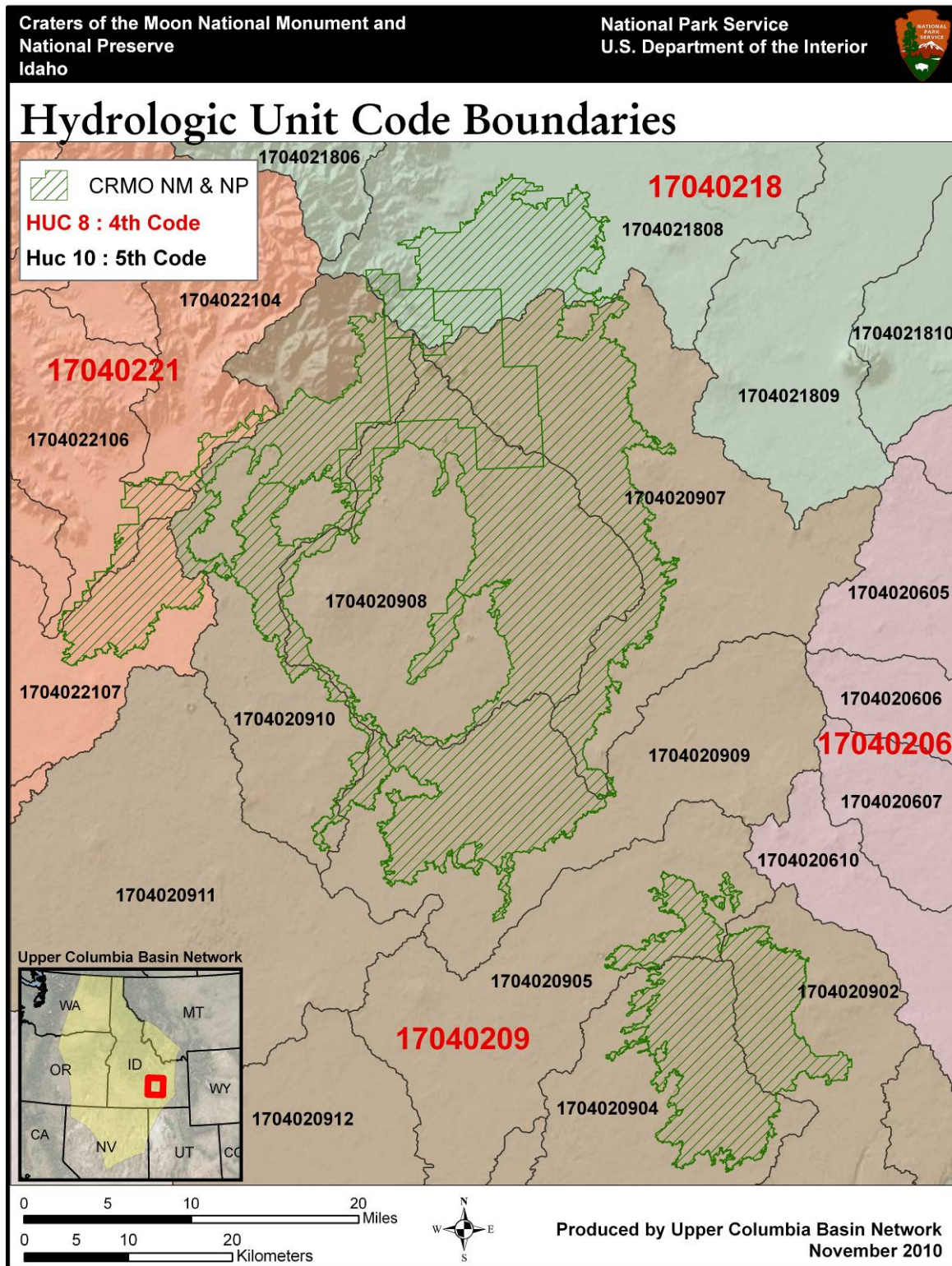
United States EPA. 2001. Environmental Monitoring and Assessment Program (EMAP): National Coastal Assessment Quality Assurance Project Plan 2001-2004. United States Environmental Protection Agency, Office of Research and Development, National Health and Environmental Effects Research Laboratory, Gulf 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.

Appendix A. 2013 Water Quality Monitoring Locations



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. Quality Control (QC) Indicators

QC data quality indicators for 2013 season at CRMO- Little Cottonwood Creek, Hydrolab #095, Station ID: CRMO-Little Cottonwood Creek #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	0.14	0.02	0.05	0.05
Specific Conductance	µS/cm	0 to 100,000 µS/cm	N/A	N/A	1.6	0.5	0.13	0.07
Dissolved Oxygen	mg/L	0-20 mg/L	N/A	N/A	0.10	0.04	0.48	0.25
pH	pH units	0-14 Units	N/A	N/A	0.27	0.05	0.87	0.00
Turbidity	NTU	0-3000 NTU	0.2	0.49	0.6	0.4	11.76	0.00

Appendix E. Corrections History

Correction history for Little Cottonwood Creek, CRMO 2013 temperature data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
N/A	No Corrections Applied	N/A	N/A	N/A	0

Correction history for Little Cottonwood Creek, CRMO 2013 specific conductance data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
N/A	No Corrections Applied	N/A	N/A	N/A	0

Correction history for Little Cottonwood Creek, CRMO 2013 dissolved oxygen data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
N/A	No Corrections Applied	N/A	N/A	N/A	0

Correction history for Little Cottonwood Creek, CRMO 2013 pH data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
EStarkey	Delete point(s)- outlier	6/21/2013 9:00	6/21/2013 9:00	7/31/2013 14:56	1

Correction history for Little Cottonwood Creek, CRMO 2013 turbidity data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
EStarkey	Delete point(s)- outlier	6/21/2013 13:30	6/21/2013 13:30	7/31/2013 14:58	1

Appendix F. Macroinvertebrate Metrics

NPS Upper Columbia Basin Benthos 2013 – CRMO, Little Cottonwood Creek

*Standardized to OTU and fixed count

SampleID	151067
Station (NAMC)	CRMO-LC-01
Station (Customer)	CRMO-001
Waterbody	Little Cottonwood Creek
County	Butte
State	ID
Latitude	43.48725
Longitude	-113.591699
Collection Date	6/21/2013
Habitat Sampled	Targeted Riffle
Collection Method	Kick net
Field Notes	500 µm net mesh
Lab Notes	NULL
Area sampled (m²)	0.72
Field Split	100
Lab Split	100
Split Count	416
Fixed Count	300
Big Rare Count	0
Richness*	29
Abundance	578
Shannon's Diversity*	2.574397358
Simpson's Diversity*	0.895830546
Evenness*	0.764529607
# of EPT Taxa*	15
EPT Taxa Abundance	404
Dominant Family	Chloroperlidae
Abundance of Dominant Family	110
Dominant Taxa	Sweltsa
Abundance of Dominant Taxa	96
Hilsenhoff Biotic Index*	2.75
# of Intolerant Taxa*	9
Intolerant Taxa abundance	233
# of Tolerant Taxa*	0
Tolerant Taxa abundance	0
USFS Community Tolerance Quotient (d)*	55
# of shredder taxa*	5
Shredder Abundance	33

Appendix F. Macroinvertebrate Metrics (continued)

NPS Upper Columbia Basin Benthos 2013 – CRMO, Little Cottonwood Creek

*Standardized to OTU and fixed count

SampleID	151067
Station (NAMC)	CRMO-LC-01
Station (Customer)	CRMO-001
Waterbody	Little Cottonwood Creek
County	Butte
State	ID
Latitude	43.48725
Longitude	-113.591699
Collection Date	6/21/2013
Habitat Sampled	Targeted Riffle
Collection Method	Kick net
# of scraper taxa*	2
Scraper abundance	96
# of collector-filterer taxa*	1
Collector-filterer abundance	3
# of collector-gatherer taxa*	9
Collector-gatherer abundance	211
# of predator taxa*	8
Predator abundance	129
# of clinger taxa*	7
Long-lived Taxa*	4
# of Ephemeroptera taxa*	6
Ephemeroptera abundance	243
# of Plecoptera taxa*	5
Plecoptera abundance	129
# of Trichoptera taxa*	4
Trichoptera abundance	32
# of Coleoptera taxa*	3
Coleoptera abundance	92
# of Elmidae Taxa*	1
Elmidae abundance	67
# of Megaloptera taxa*	0
Megaloptera abundance	0
# of Diptera taxa*	8
Diptera abundance	71
# of Chironomidae taxa*	1
Chironomidae abundance	51
# of Crustacea taxa*	0
Crustacea abundance	0

Appendix F. Macroinvertebrate Metrics (continued)

NPS Upper Columbia Basin Benthos 2013 – CRMO, Little Cottonwood Creek

*Standardized to OTU and fixed count

SampleID	151067
Station (NAMC)	CRMO-LC-01
Station (Customer)	CRMO-001
Waterbody	Little Cottonwood Creek
County	Butte
State	ID
Latitude	43.48725
Longitude	-113.591699
Collection Date	6/21/2013
Habitat Sampled	Targeted Riffle
Collection Method	Kick net
# of Oligochaete taxa*	0
Oligochaete abundance	0
# of Mollusca taxa*	1
Mollusca abundance	3
# of Insect taxa*	26
Insect abundance	567
# of Non-insect taxa*	3
Non-insect abundance	11

Appendix G. Standardized Species Matrix

NPS Upper Columbia Basin Benthos 2013 – CRMO
Sample ID: 151067, Station (NAMC): CRMO-LC-01, Sample Date: 06/21/2013
Note that all samples were from targeted riffles and sampled using kick nets.

OTUCode	Phylum	Class	Order	Family	Genus	Species	OTUName	Count
513						Turbellaria		3
5	Annelida					Other_Oligochaeta		0
7	Arthropoda					Acari		3
29	Arthropoda	Insecta	Coleoptera	Dytiscidae		Sanfilippodytes		1
344	Arthropoda	Insecta	Coleoptera	Elmidae		Heterolimnius		86
58	Arthropoda	Insecta	Coleoptera	Hydrophilidae		Ametor		4
63	Arthropoda	Insecta	Coleoptera	Hydrophilidae		Enochrus		0
244	Arthropoda	Insecta	Diptera			Simuliidae		0
80	Arthropoda	Insecta	Diptera	Ceratopogonidae		Ceratopogoninae		1
84	Arthropoda	Insecta	Diptera	Chironomidae		Chironominae		0
86	Arthropoda	Insecta	Diptera	Chironomidae		Orthocladiinae		51
89	Arthropoda	Insecta	Diptera	Chironomidae		Tanypodinae		0
223	Arthropoda	Insecta	Diptera	Dixidae		Dixa		1
225	Arthropoda	Insecta	Diptera	Dixidae		Meringodixa		3
237	Arthropoda	Insecta	Diptera	Pelecorhynchidae		Glutops		1
245	Arthropoda	Insecta	Diptera	Stratiomyidae		Caloparyphus_Euparyphus		1
254	Arthropoda	Insecta	Diptera	Tipulidae		Dicranota		3
257	Arthropoda	Insecta	Diptera	Tipulidae		Hexatoma		0
259	Arthropoda	Insecta	Diptera	Tipulidae		Limnophila		1
265	Arthropoda	Insecta	Diptera	Tipulidae		Tipula		7
271	Arthropoda	Insecta	Ephemeroptera	Baetidae		Baetis		76
277	Arthropoda	Insecta	Ephemeroptera	Baetidae		Dipheter		17
1796	Arthropoda	Insecta	Ephemeroptera	Ephemerellidae		Ephemerella		0
298	Arthropoda	Insecta	Ephemeroptera	Ephemerellidae		Serratella		43
290	Arthropoda	Insecta	Ephemeroptera	Ephemerellidae		Drunella_coloradensis_flavilinea		57

Appendix G. Standardized Species Matrix (continued)

OTUCode	Phylum	Class	Order	Family	Genus	Species	OTUName	Count
143	Arthropoda	Insecta	Ephemeroptera	Heptageniidae		Cinygma		0
302	Arthropoda	Insecta	Ephemeroptera	Heptageniidae		Cinygmula		39
303	Arthropoda	Insecta	Ephemeroptera	Heptageniidae		Epeorus		0
321	Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae		Paraleptophlebia		11
359	Arthropoda	Insecta	Plecoptera			Chloroperlidae		96
367	Arthropoda	Insecta	Plecoptera	Nemouridae		Zapada		1
370	Arthropoda	Insecta	Plecoptera	Peltoperlidae		Yoraperla		4
372	Arthropoda	Insecta	Plecoptera	Perlidae		Calineuria		1
374	Arthropoda	Insecta	Plecoptera	Perlidae		Doroneuria		6
379	Arthropoda	Insecta	Plecoptera	Perlodidae		Isoperla		7
403	Arthropoda	Insecta	Trichoptera	Glossosomatidae		Anagapetus		0
427	Arthropoda	Insecta	Trichoptera	Lepidostomatidae		Lepidostoma		3
434	Arthropoda	Insecta	Trichoptera	Limnephilidae		Chyrandra		15
443	Arthropoda	Insecta	Trichoptera	Limnephilidae		Psychoglypha		3
462	Arthropoda	Insecta	Trichoptera	Rhyacophilidae		Rhyacophila_brunnea_vemna_groups		7
481	Arthropoda	Insecta	Trichoptera	Uenoidae		Neophylax		0
499	Mollusca	Bivalvia	Veneroida			Pisidiidae		3

Note: BLM/USU National Aquatic Monitoring Center—"Species Matrix (Standardized): Taxonomic and abundance data standardized to Operational Taxonomic Units (OTUs) but not standardized to fixed count. Please note that data has not been standardized to a fixed count as in the 'Standardized Metrics worksheet'. Also, abundance data is the estimated number per square meter for quantitative samples OR is the estimated number per sample for qualitative samples."

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 131/126199, August 2014

National Park Service
U.S. Department of the Interior



Natural Resource Stewardship and Science

1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

www.nature.nps.gov

EXPERIENCE YOUR AMERICA™