



## Water Quality Monitoring in Big Hole National Battlefield (BIHO)

### Importance

Freshwater habitats are diverse and productive ecosystems, providing habitat for aquatic plant, invertebrate, and vertebrate species including many fishes and birds. Rivers and streams are intimately connected to riparian zones, providing habitat for many specialist species. Additionally, most upland animals rely on aquatic habitats to one degree or another. Water resources in the semi-arid west have been strongly affected by human activity, and all UCBN streams and rivers are listed by states as impaired for one or more parameters. Most UCBN waterbodies 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 shifting climate and dynamic human influences.



Beaver dam on the North Fork Big Hole River – near Wisdom MT.

### Status at Big Hole National Battlefield (BIHO)

Threats to water resources in BIHO have been listed as: flow impairment, mining, agriculture, and stormwater runoff. In addition, the North Fork Big Hole River is listed as impaired on the EPA 303(d) list as impaired due to dewatering (Garrett et al. 2007). In 2009 the UCBN monitored 5 core water chemistry parameters in the North Fork Big Hole River including: dissolved oxygen, pH, specific conductance, temperature, and turbidity. Each parameter was evaluated hourly between the months of June and October using a continuous water quality monitor. In addition, aquatic macroinvertebrates were collected using the EPA’s Environmental Monitoring and Assessment Program (EMAP) protocol. For more on macroinvertebrates please see the integrated water quality annual report for BIHO on the UCBN website listed below.

Results indicate that most core parameters are within state regulatory thresholds; however, dissolved oxygen levels are slightly below the suggested threshold. The following table is a basic summary of findings from 2009 monitoring along with state regulatory thresholds for the North Fork Big Hole River.

North Fork Big Hole River Water Chemistry Summary 2009

| Measure                           | Current Condition (June-October, 2009) | State DEQ Thresholds   |
|-----------------------------------|--|--|
| Temperature (*MDMT, **MDAT)       | * MDMT= 19.06 °C<br>** MDAT= 17.10 °C  | “A 1 °F [0.56 °C] maximum increase above naturally occurring water temperature is allowed” |
| Specific Conductance (mean)       | 54.5 µS/cm                             | N/A  |
| Dissolved oxygen (mean daily min) | 7.37 mg/L                              | Daily minimum > 8.0 mg/L;<br>7-d mean > 9.5 mg/L   |
| pH (mean daily max)               | 7.37 pH Units                          | 6.0-8.5; < 0.5 unit human induced change; Maintain >7.0 if naturally > 7.0                 |
| pH (mean daily min)               | 7.14 pH Units                          | 6.0-8.5; < 0.5 unit human induced change; Maintain >7.0 if naturally > 7.0                 |
| Turbidity (mean daily max)        | 18.8 NTU                               | “No increase above natural turbidity is allowed”   |

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



North Fork Big Hole River

### Discussion

The lack of historical water chemistry data from the North Fork Big Hole River limits comparisons between data collected in 2009 and the state regulatory thresholds. Low dissolved oxygen levels may indicate that water temperatures are elevated relative to “naturally occurring” conditions. Heavy rain on recently burned upstream areas increased turbidity levels in late July and early August. UCBN water quality monitoring is conducted on a 3 year rotating panel. North Fork Big Hole River will be sampled for water chemistry and macroinvertebrates again in 2012.

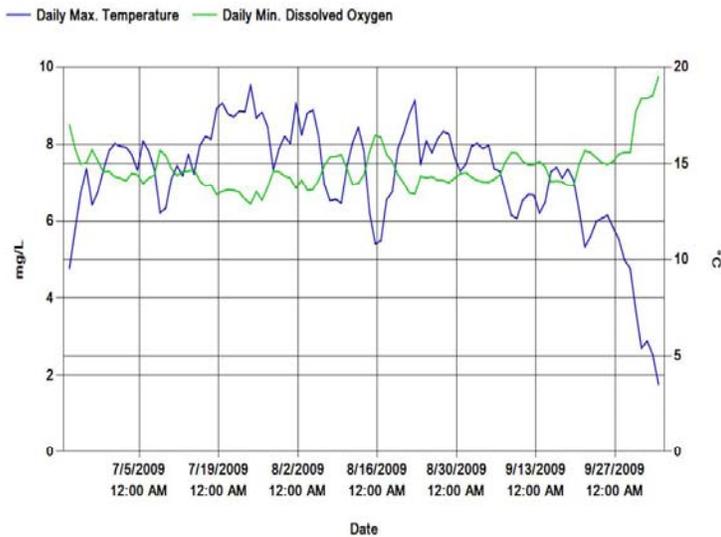
### Contact Information

Eric Starkey, Eric\_Starkey@nps.gov



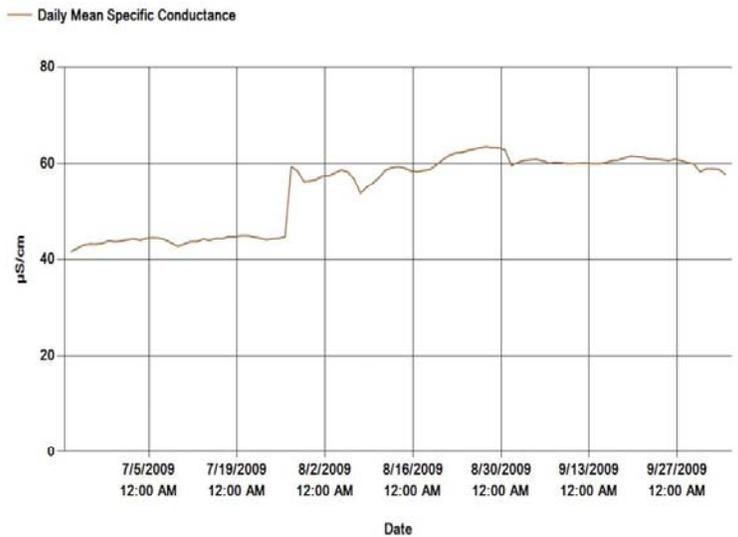
### Monitoring Data for North Fork Big Hole River (BIHO), 2009

Daily Min. Dissolved Oxygen and Daily Max. Temperature



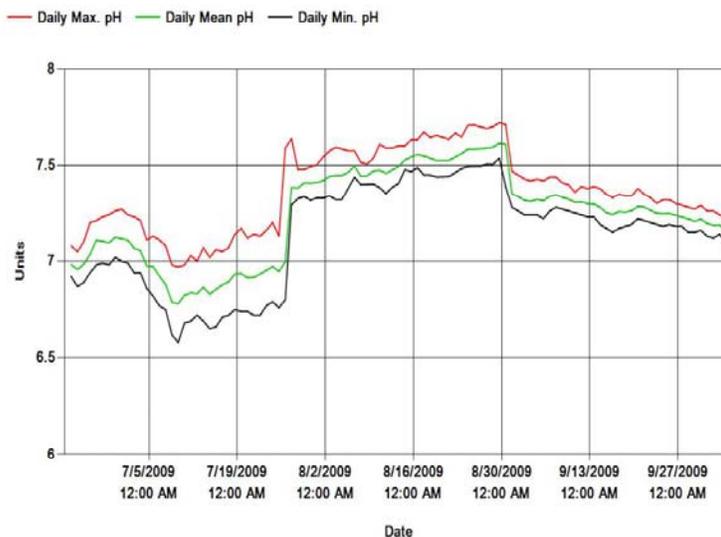
The maximum daily average temperature was 17.10 °C. Daily minimum dissolved oxygen was routinely below the regulatory daily minimum of 8.0 mg/L.

Daily Mean Specific Conductance



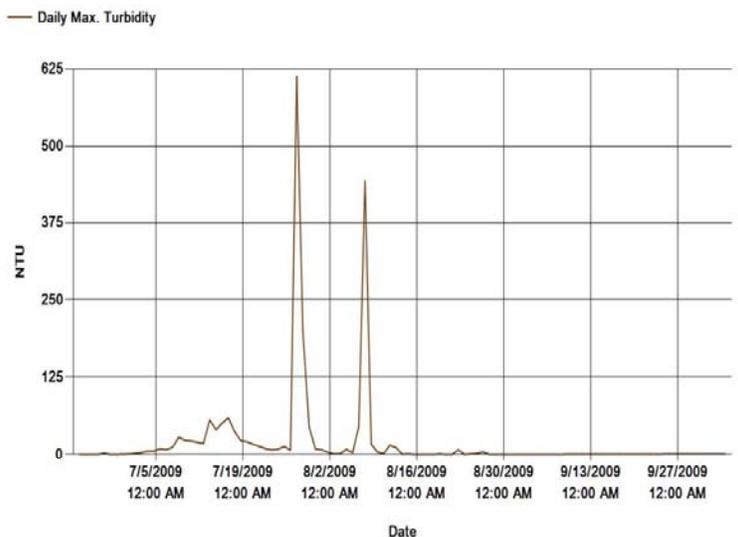
The mean specific conductance was 54.5 µS/cm. There is no established threshold for specific conductance. The increase in specific conductance seen in late July and early August corresponded to inflow of sediment from a recently burned area upstream.

Daily Min., Max., and Mean pH



The minimum, maximum, and mean pH were never outside the acceptable regulatory thresholds of 6.0-8.5 pH units.

Daily Maximum Turbidity



Maximum turbidity ranged from 0 NTU to 613 NTU. The increased turbidity in late July and early August correspond to rain events and the inflow of sediment from a recently burned area upstream. After settling out of the water column, this sediment covered much of the substrate.

#### Important Notes:

Where necessary, data has been corrected for fouling and drift error according to guidelines established by the USGS.