# FLATHEAD STILLWATER TMDL PLANNING AREA TEMPERATURE AND INSTANTANEOUS FLOW MONITORING

## *Sampling and Analysis Plan*

**Prepared by:**

**MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY**
Watershed Management Section, Water Quality Planning Bureau
1520 East 6th Avenue
Helena, MT 59620-0901

**Approvals**

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|---|---|
| _____ | _____ |
| Kyle Flynn, P.H. (Hydrologist) | Date |
| _____ | _____ |
| Michael Pipp (Watershed Modeling Program Supervisor) | Date |
| _____ | _____ |
| Rosie Sada (WQ Monitoring Section Supervisor) | Date |
| _____ | _____ |
| Mark Bostrom (QA Officer) | Date |
| _____ | _____ |
| Jim Bond (TMDL Project Manager) | Date |

This document constitutes the Sampling and Analysis Plan (SAP) for the completion of a temperature source assessment and loading estimates and the establishment of reference conditions for the Flathead Stillwater TMDL planning area (TPA).

## 1.0 Introduction and Background

The Flathead-Stillwater TMDL planning area (FSTPA) encompasses approximately 1,150 square miles (739,629 acres) in northwest Montana. Draining southerly to Flathead Lake, the FSTPA is bordered by the Flathead Headwaters TPA and Glacier National Park to the east and contains one of the fastest developing areas in Montana which includes the cities of Whitefish, Columbia Falls, and Kalispell.

Under Montana law, an impaired water body is defined as a water body for which sufficient and credible data indicates non-compliance with applicable water quality standards (MCA 75-5-103). Section 303 of the Federal Clean Water Act requires states to submit a list of impaired water bodies or stream segments to the U.S. Environmental Protection Agency (EPA) every two years. Prior to 2004, this list was referred to as the "303(d) list", but is now named the "Integrated Report". The Montana Water Quality Act further directs states to develop TMDLs for all water bodies appearing on the 303(d) list as impaired or threatened by "pollutants" (MCA 75-5-703).

Three stream segments in the Flathead Stillwater TPA appeared on Montana's 2006 Clean Water Act Section 303(d) list for temperature impairment. They are: the upper and lower segments of Ashley Creek, and the Whitefish River. For the purposes of this study, temperature data loggers will be deployed throughout the length of Ashley Creek and the Whitefish River, and shade and flow measurements will be collected to characterize the entire streams.

Possible temperature influences in the basin may be the result of riparian degradation from timber harvest and agriculture, decreases in flow during portions of the summer from irrigation and/or natural infiltration into the ground, and irrigation return flows.

## 2.0 Objectives and Design

The objective of this sampling plan is to collect temperature, riparian cover, and flow data that will be used to identify gaining/losing areas for temperature and to locate areas where the implementation of best management practices would decrease stream temperatures. This information will be incorporated into a modeling effort that will represent existing conditions, as well as simulate various management options that may affect temperature. The results of this study will be the basis for the development of the temperature TMDL and allocations for Whitefish River and Ashley Creek.

## Study Design

Sampling Sites

Thirty two data logger sites will be located along the two listed streams (Table 1; Figures 1-5). There will be 21 sites on Ashley Creek, and 11 on Whitefish River. In addition to the data logger deployment, flow will be measured at most of the designated temperature sampling sites (see Table 1 for details). Sampling sites were identified by both assessment of aerial images and field surveying to capture areas where stream temperature could be influenced by changes in land cover/land use and flow (via irrigation ditches and tributaries).

**All sites are subject to change based on access availability and flow conditions.*

Temperature loggers will record data every 30 minutes throughout the life of their deployment. Temperature loggers will be deployed beginning in mid July and will collect information until they are retrieved in late September or early October. Specific deployment and retrieval dates are dependent upon availability of PBS&J personnel.

**Table 1 – Flathead Stillwater Temperature Sampling Locations**

| Stream | Site ID | Temp | Flow | Latitude | Longitude |
|---|---|---|---|---|---|
| Whitefish River | WHTF-01 | yes | yes | -114.35110667600 | 48.41400724980 |
| Whitefish River | WHTF-02 | yes | no | -114.33472685200 | 48.40155893700 |
| Tributary | WHTF-04 | yes | yes | -114.30077994000 | 48.37692125550 |
| Haskill Creek | WHTF-03 | yes | yes | -114.31202219400 | 48.38672588690 |
| Whitefish River | WHTF-05 | yes | yes | -114.30224419200 | 48.37023475450 |
| Whitefish River | WHTF-06 | yes | no | -114.27411742500 | 48.34206042260 |
| Whitefish River | WHTF-07 | yes | yes | -114.27839678300 | 48.31927759950 |
| Whitefish River | WHTF-08 | yes | no | -114.28895195900 | 48.29065062390 |
| Whitefish River | WHTF-09 | yes | yes | -114.28772982800 | 48.25609321710 |
| Whitefish River | WHTF-10 | yes | no | -114.29222990300 | 48.24009957650 |
| Whitefish River | WHTF-11 | yes | yes | -114.28690374000 | 48.21380900390 |
| Ashley Creek | ASHL-01 | yes | yes | -114.61793268200 | 48.18006936170 |
| Ashley Creek | ASHL-02 | yes | yes | -114.60345469700 | 48.17802432050 |
| Ashley Creek | ASHL-03 | yes | yes | -114.60204339900 | 48.15812100960 |
| Ashley Creek | ASHL-04 | yes | yes | -114.60019685100 | 48.14672268190 |
| Ashley Creek | ASHL-05 | yes | yes | -114.56969016200 | 48.12548630050 |
| Ashley Creek | ASHL-06 | yes | yes | -114.56230614600 | 48.10021058800 |
| Tributary | ASHL-07 | yes | yes | -114.56342270200 | 48.09868547840 |
| Ashley Creek | ASHL-08 | yes | yes | -114.50474445700 | 48.08934302830 |
| Ditch | ASHL-09 | yes | yes | -114.49443131700 | 48.09244258720 |
| Ditch | ASHL-10 | yes | yes | -114.47334772800 | 48.10098144980 |
| Ashley Creek | ASHL-11 | yes | yes | -114.45951613600 | 48.10607814770 |
| Ashley Creek | ASHL-12 | yes | yes | -114.43795571200 | 48.13337240980 |
| Ashley Creek | ASHL-13 | yes | yes | -114.42894173300 | 48.16633435550 |

| | | | | | |
|---|---|---|---|---|---|
| Ashley Creek | ASHL-14 | yes | yes | -114.42828583700 | 48.16874406170 |
| Borman Creek | ASHL-15 | yes | yes | -114.39554071200 | 48.18645873040 |
| Spring Creek | ASHL-17 | yes | yes | -114.33155349300 | 48.18880402880 |
| Ashley Creek | ASHL-16 | yes | yes | -114.33728290900 | 48.19250421970 |
| Ashley Creek | ASHL-18 | yes | yes | -114.30855908800 | 48.17435819950 |
| Ashley Creek | ASHL-19 | yes | yes | -114.28539654600 | 48.14666756930 |
| Ashley Creek | ASHL-20 | yes | yes | -114.24428366400 | 48.13570634190 |
| Ashley Creek | ASHL-21 | yes | no | -114.21118341900 | 48.15674828540 |

Solar Pathfinder

A Solar Pathfinder will be used to get information pertaining to current shade conditions. This information will be used in conjunction with the temperature data to compare available shade at sites and determine shade potential for simple modeling procedures. Shade information will be collected at 15 sites per stream, representing 5 differing categories: forested, dense riparian (deciduous), low/moderate riparian (deciduous), urban, and open/pasture. Three sites of each category should be sampled. Sites should also represent varying geographic aspects relative to the path of the sun. These sites have not yet been identified but will be determined via aerial analysis and accessibility in the field.

Qual2K Model

The data collected through this field effort will be incorporated into a Qual2K modeling exercise. Qual2K has the ability to simulate diurnal heat budgeting, water quality kinetics, heat and mass inputs, and point and non-point loads and abstractions. Qual2K will be able to provide a much more specific account of changes in temperature and influencing factors to determine impairment.

## 3.0 Field Sampling Methods

Monitoring (including instrument calibration) will be done in accordance with the MDEQ's Field Procedures Manual (DEQ, 2005). A site form (Continuous Data Logger Field Form) will be completed for each site that includes GPS coordinates, time, weather, a hand drawn site sketch indicating temperature logger locations and any other observations. Instantaneous flow will be measured during the critical temperature limited period. If time and budget allow, an additional flow measurement event will occur at the time of data logger retrieval. Stream discharge data will be collected using a *Marsh McBirney Flo-Mate 2000*™ current velocity meter and standard USGS area-velocity method. If stream depth exceeds 2.5-3.0 feet, flow may be measured from a bridge using standard USGS methodology (bridge board, bridge crane). Any bridge measurements should also include the appropriate adjustments for deflection, etc to provide the most accurate measurement possible. All safety measures should be taken appropriate to the method used including traffic awareness and safety at bridge sites. Solar Pathfinder data will be collected according to standard methods and procedures provided with the Solar Pathfinder.

Sites are located in areas of low public use (to avoid theft), under vegetative cover, usually along banks, and temperatures are manually taken at the time of deployment to

ensure that loggers are correctly recording when data are later downloaded. Units are checked mid-summer to ensure they are submerged during low water, and logger condition is noted on data sheets. Condition of the logger is also noted when loggers are removed in the fall. When possible, loggers are attached by a hose clamp or piece of wire to a two foot piece of rebar that is driven into the stream bed and attached vertically using a plastic wire tie (see picture). In cases where the use of rebar is impractical, tent stakes are used in which holes have been drilled and through which adjustable clamps are threaded to attach the loggers. Bricks may also be used to anchor loggers and are similarly attached using plastic wire tie however bricks should not be used in areas of silt or heavy sediment that would prohibit the logger from free flow of water over the device.


## 4.0 Quality Assurance and Quality Control Requirements

All QA/QC requirements followed by Montana DEQ will be instituted for this project. The QA/QC requirements are described in DEQ (2005b). QA/QC will consist of deploying duplicate temperature loggers at approximately 10% frequency. Additionally, manual temperature measurement will be completed during deployment and retrieval phases to ensure the units are functioning properly.

Calibration and Precision

All temperature data loggers will be calibrated prior to deployment and again post retrieval. Pre and post calibration is necessary to control and understand any bias that may be present in the data. Instructions for calibration can be found in the Temperature Data Logger Protocols Standard Operating Procedure referenced in Section 8.

To measure precision over the course of a study, two loggers can be placed at a site creating replicate measures of the sampling point. Replicates measures will be performed at a 10% frequency (3 sites). The values obtained from a replicate deployment should not vary more than +/- 0.5 degrees C for readings taken at the same time. Effective precision for the continuous temperature data loggers is +/- .2$^{o}$F.

## 5.0 Data Analysis, Record Keeping, and Reporting Requirements

Site Visit forms will be properly completed for all samples. Written field notes and forms will be processed by DEQ staff following the internal QA/QC process. Data generated during this project will be managed according to the Data Management Business Plan (in review). Flow data will be entered into STORET by DEQ staff and temperature logger data will be stored in a project folder on the DEQ network, which is backed up daily.

## 6.0 Schedule for Completion

*Tentative*:
July 14-21: Deployment
Sept 22: Retrieval
November 2008 –February 2009: Temperature Modeling and Scenarios

## 7.0 Project Team and Responsibilities

Project Team:
DEQ:
Jim Bond – Senior TMDL Planner; Project design and data analysis
Kyle Flynn – Hydrologist; Project design and data analysis

PBS&J:
John DeArment – Project Manager
Jeff Dunn – Project Implementation; Modeling
Robin Smith – Field Technician

## 8.0 References

DEQ 2005a. Water Quality Planning Bureau Field Procedures Manual for Water Quality Assessment Monitoring. Montana Dept. of Environmental Quality, WQPBWQM-020, revision 2. April 21, 2005. *Available at* http://www.deq.state.mt.us/wqinfo/QAProgram/SOP%20WQPBWQM-020.pdf

DEQ 2005a. Temperature Data Logger Protocols Standard Operating Procedure. Montana Dept. of Environmental Quality, WQPBWQM-006, revision 1. December 4, 2005.
*Available at* http://www.deq.mt.gov/wqinfo/QAProgram/SOP%20WQPBWQM-006.pdf

DEQ. 2005b. Quality Assurance Project Plan (QAPP) Sampling and Water Quality Assessment of Streams and Rivers in Montana, 2005. *Available at* http://www.deq.state.mt.us/wqinfo/QAProgram/WQPBQAP-02.pdf.

DEQ. In review. Draft Water Quality Planning Bureau Data Management Business Plan.WQPBDMS-003.

Figure 1 – Ashley Creek Sampling Locations

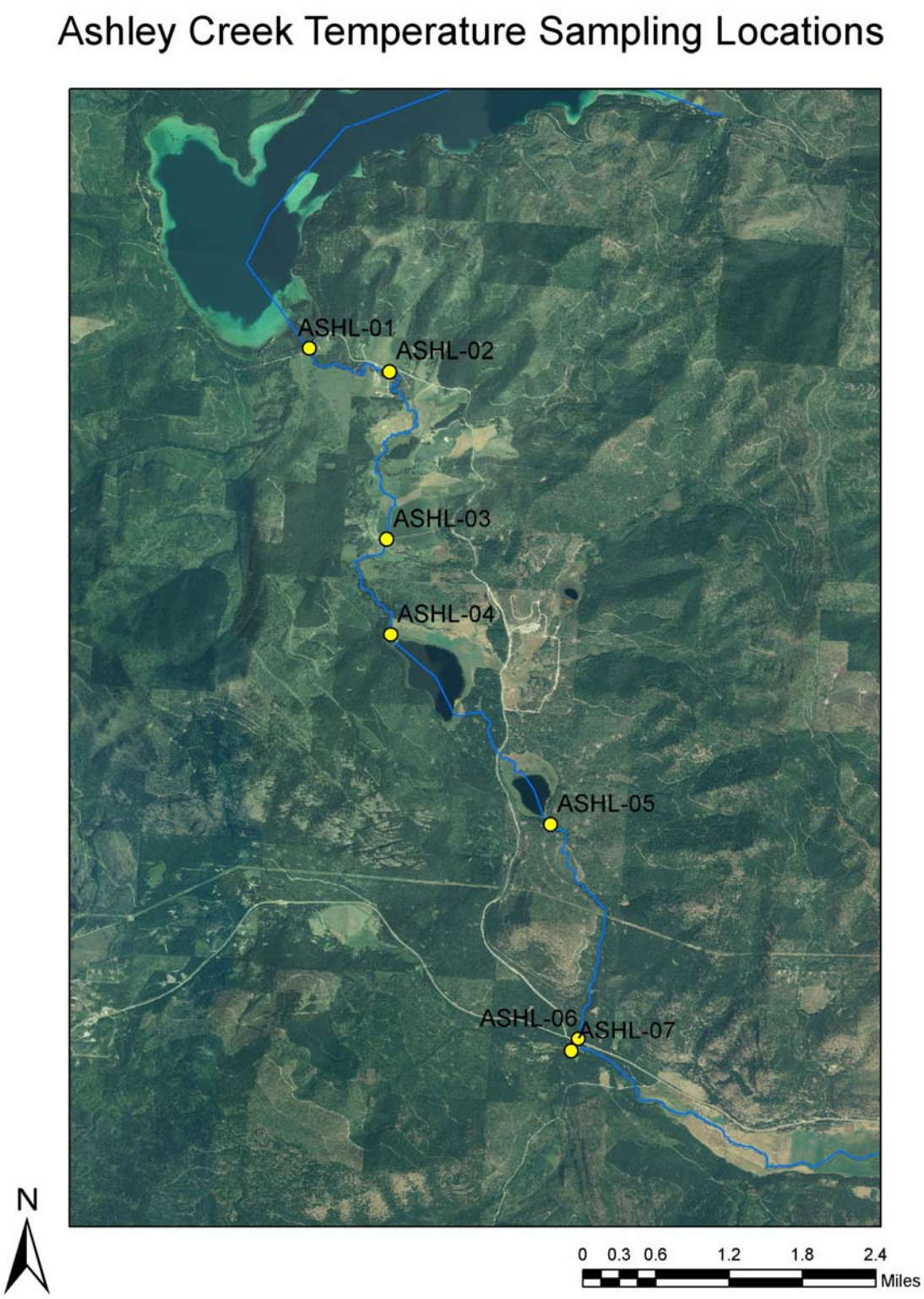

Figure 2 – Ashley Creek Sampling Locations

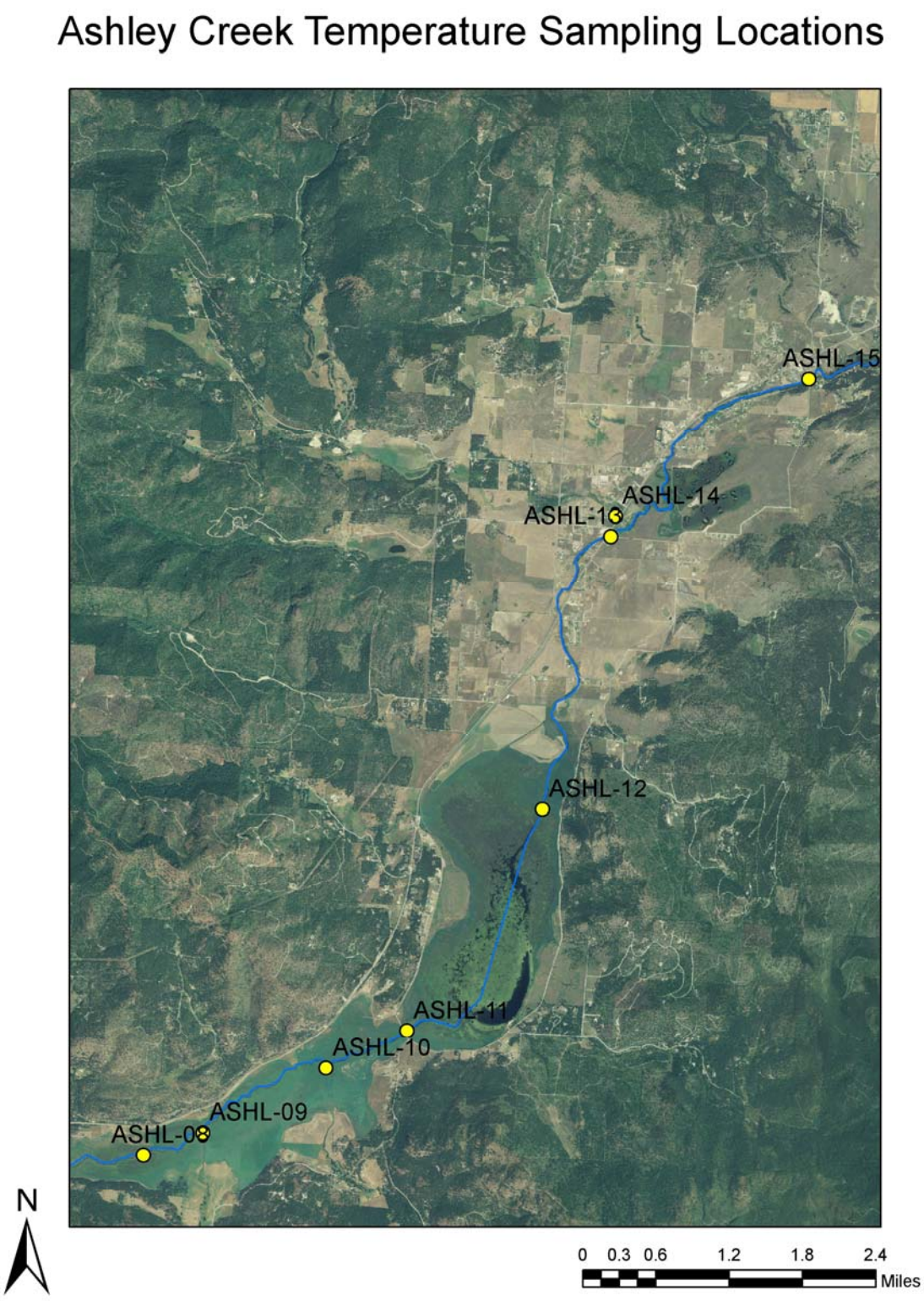

Figure 3 – Ashley Creek Sampling Locations

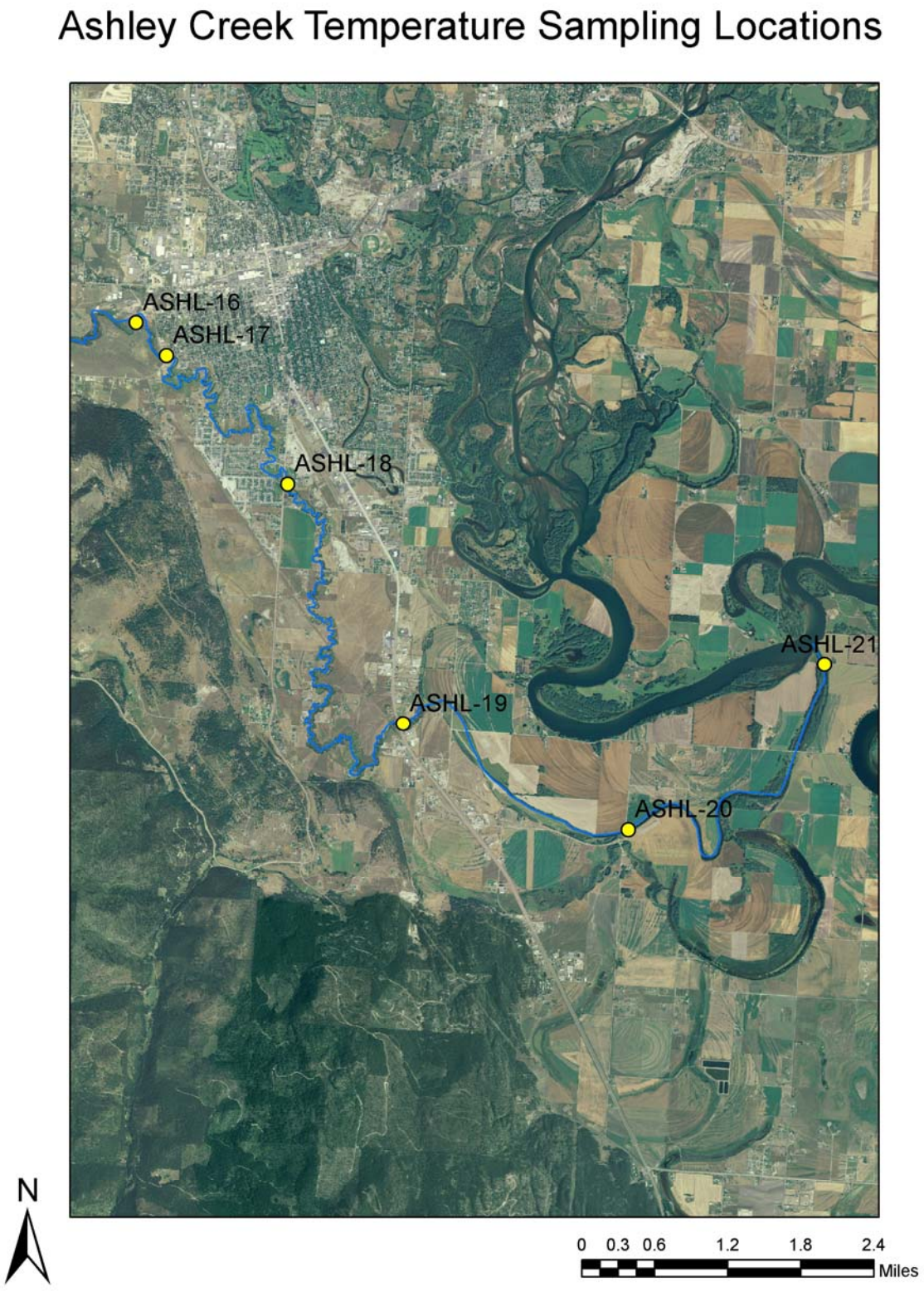

Figure 4 – Whitefish River Sampling Locations

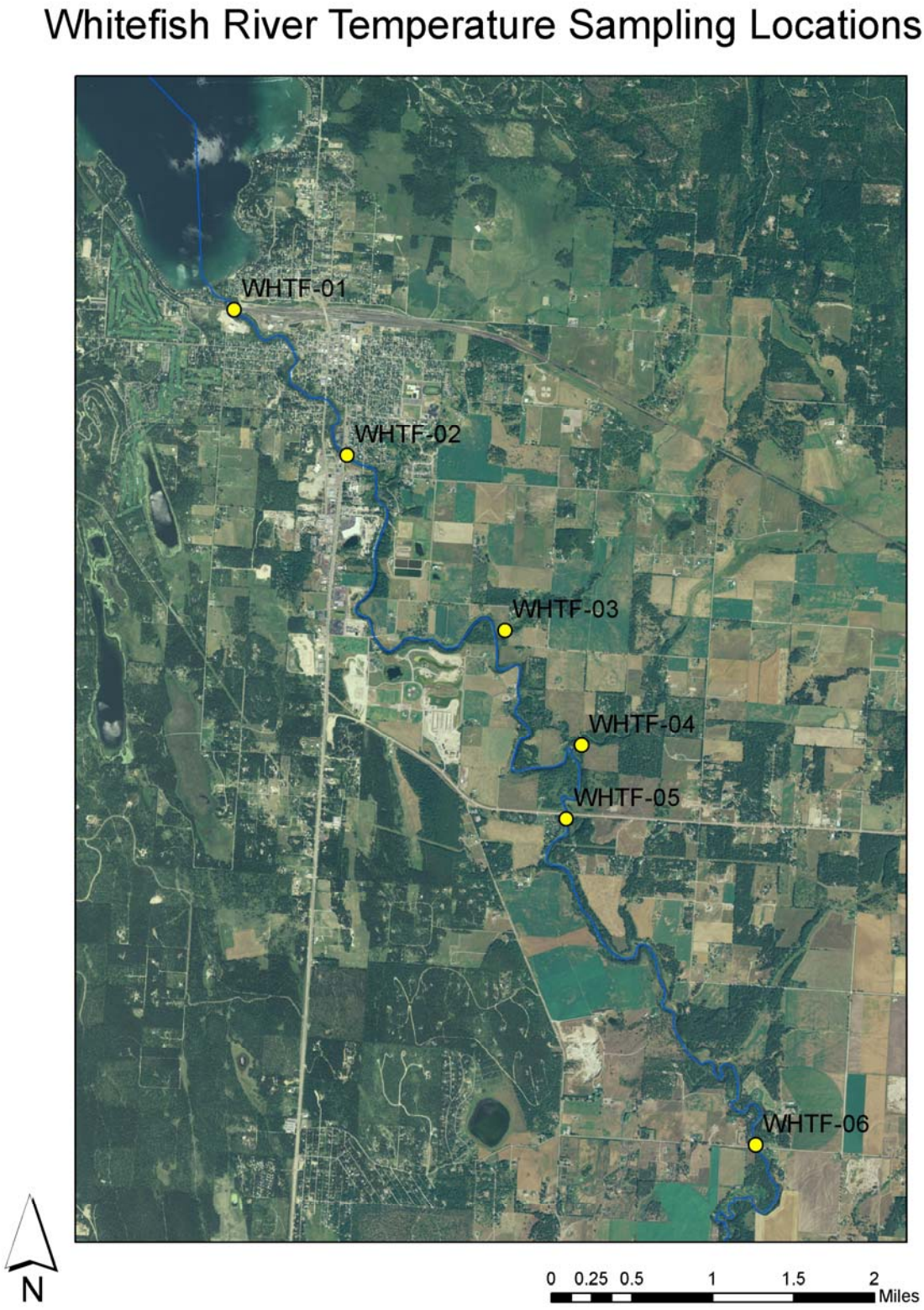

Figure 5 – Whitefish River Sampling Locations