Quality Control Report

Bad River Watershed Association's (BRWA) 2012 "Staff Baseline Water Quality Monitoring Near the Potential Penokee Iron Ore Mine - Continuous Temperature, Macroinvertebrate, and Conductivity"

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Summary:

The following report satisfies quality assurance reporting outlined in section C2 of BRWA's Quality Assurance Project Plan (QAPP) entitled "Staff Baseline Water Quality Monitoring Near the Potential Penokee Iron Ore Mine - Continuous Temperature, Macroinvertebrate, and Conductivity."

An addendum to the 2011 QAPP was completed to reflect monitoring activities that occurred during 2012. All other aspects of the project described in the 2011 QAPP for continuous temperature and macroinvertebrate remained the same for 2012 staff monitoring activities. Limited conductivity measurements were taken during 2012 and are not included in this quality control report. This report notes any changes in methodology or quality control that occurred during the course of project implementation (see "Deviations").

During 2012, BRWA staff maintained and retrieved eight thermistors as part of the project described in the aforementioned QAPP (Table 1). BRWA also began a volunteer temperature monitoring program during 2012. Eight thermistors were maintained and retrieved by BRWA volunteers during 2012 (Table 2).

Volunteers were trained and responsible for deploying, doing field checks, and retrieving their thermistors using similar protocols as BRWA staff. BRWA staff conducted all quality control and data

Volunteers were trained and responsible for deploying, doing field checks, and retrieving their thermistors using similar protocols as BRWA staff. BRWA staff conducted all quality control and data management with the volunteer thermistors as described in the staff QAPP. For the purposes of this report, thermistors that were field-maintained by BRWA staff are separated from thermistors field-maintained by volunteers.

Table 1. Sites monitored for continuous temperature and macroinvertebrates by Bad River Watershed Association staff during 2012 near the site of a potential open-pit iron ore mine between Mellen and Hurley, WI. Site coordinates are given in decimal degrees (DD).

Stream	Site Location	Longitude (DD)	Latitude (DD)	Temp Site	Macro Site	Notes
Tyler Forks River	Caroline Lake Rd.	-90.502850	46.277116	X	X	Temp Logger Lost
Tyler Forks River	Hwy. 77	-90.494603	46.347492		X	
Tyler Forks River	Stricker Rd.	-90.590000	46.394720		X	
Potato River	Upson Park	-90.412086	46.370889	X	X	Temp Logger Lost
Erickson Creek	Casey Sag Rd.	-90.465233	46.372039	X	X	
Rouse Creek	Casey Sag Rd.	-90.465767	46.360833	X		
Javorsky Creek	Hwy. 77	-90.518417	46.344836		X	
Opergard Creek	Near Revai Rd.	-90.586017	46.341617	X	X	
Unnamed Tyler Forks Tributary	Forest Road 703	-90.501528	46.290863	X		
Devils Creek	Off Opergard Rd	-90.592891	46.317543		X	
Ballou Creek	Red House Rd.	-90.575977	46.305917	X	X	
Bad River	Gilman Park	-90.66322	46.32292	X	X	Coordinates in BRWA's QAPP and 2011 QC report are erroneous; these are correct
Bad River	Caroline Lake Outflow	-90.56162	46.267905	X		
City Creek	Lake Dr.	-90.644975	46.308677	X	X	

Table 2. Sites monitored by Bad River Watershed Association volunteers for continuous temperature during 2012. Site coordinates are given in decimal degrees (DD).

Stream	Site Location	Longitude (DD)	Latitude (DD)	Notes
Trout Brook Trib "Broeniman Creek"	Broeniman Rd	-90.76717	46.349483	
Unnamed Brunsweiler Trib	Hwy C (NC2)	-90.79115	46.407097	
Silver Creek	Hwy 13	-90.727394	46.386757	
Hawkins Creek	Snake Trail Rd	-90.96354	46.33599	
Little Spring Creek	Altamont Rd	-91.015015	46.35172	
Gehrman Creek	Popko Rd	-90.59107	46.374084	
Freburg Creek	Freiburg Rd	-90.42474	46.467583	
City Creek	Jokinen Rd	-90.64351	46.30522	Logger data not useable for max. daily mean
Schramm Creek	Moonshine Alley	-91.07151	46.47576	Logger lost

Staff conducted macroinvertebrate sampling according to the multi-habitat method outlined in the QAPP at sites listed in Table 1. Macroinvertebrate identifications were completed by Dr. Kurt Schmude, Lake Superior Research Institute, under established Standard Operating Procedures summarized in the QAPP.

Overall, data quality objectives for continuous temperature, macroinvertebrate, and conductivity data were met for BRWA's 2012 monitoring efforts. No significant quality assurance problems or deviations from the QAPP were identified. All data were deemed useable. In addition, several suggestions for improving data quality and data collection efforts are provided in this report.

Deviations:

There were no deviations to the QAPP during the course of staff project implementation in 2012.

Significant Quality Assurance Problems and Recommended Solutions:

There were no significant quality assurance problems identified during field or laboratory activities associated with the BRWA staff portions of the project.

There were some limitations for the use continuous temperature data collected by volunteers, mainly related to thermistors becoming buried in sediment during portions of the deployment period. These limitations and recommended use of the data are discussed in the Completeness section of the volunteer-collected continuous temperature data, below.

Suggestions for Future Improvements:

If Pendant thermistors (or other types of thermistors besides the TidbiT v2) will be used in future years, some of the data quality objectives may need to be revised to reflect the different levels of accuracy available from Pendants versus TidbiT v2 thermistors.

Recommend including a length of time (suggest two minutes) staff and volunteers should allow their field thermometers to equilibrate in a stream before recording measurements.

Recommend putting more emphasis on checking thermistors following rain events to avoid prolonged periods of time when thermistors may be buried and not recording stream temperatures. This is particularly relevant in flashy streams that tend to occur in the soil transition and clay plain areas of the Bad River watershed.

Continuous Temperature

Data Quality Indicators from QAPP:

BRWA Staff Thermistors – Alternative Measurement Sensitivity (AMS): Each thermistor was used to take ten measurements of the water bath. The standard deviation of these ten measurements was used to calculate AMS as stated in the QAPP. Results were <±0.2°C for both the pre- and post-deployment accuracy checks for all thermistors maintained by BRWA staff in the field in 2012 (Table 3). The data quality objective for AMS was met for all staff thermistors.

Table 3. Alternative Measurement Sensitivity calculated for thermistors maintained by BRWA staff in 2012 during pre- (4/13/12) and post- (11/27/12) deployment accuracy checks.

	4/13/2012	4/13/2012	11/27/2012	11/27/2012
Thermistor Number	AMS ice bath	AMS room temp.	AMS ice bath	AMS room temp.
9885848	0.11	0.03	0.06	0.07
9885855	0.09	0.04	0.06	0.06
9885856	0.18	0.18	0.06	0.06
9885860	0.08	0.05	0.04	0.06
9885864	0.05	0.03	0.05	0.07
9922449	0.06	0.04	0.09	0.07
9922451	0.09	0.04	0.03	0.06
9922452	0.10	0.05	0.04	0.06

BRWA Volunteer Thermistors – AMS: Each thermistor was used to take ten measurements of the water bath. The standard deviation of these ten measurements was used to calculate AMS as stated in the QAPP. The data quality objective for AMS was met for all thermistors except for Pendant thermistor #9691859 (Table 4).The pre-deployment room temperature check for thermistor #9691859 was greater than the AMS guideline. This is one of the Pendant thermistors. Review of the data shows that the higher AMS value for this thermistor was due to one temperature reading. There is no other evidence to indicate this thermistor was not functioning properly. The AMS target should be re-evaluated for use with the Pendant thermistors. Certified accuracy for the Pendants is ±0.5°C, so a more appropriate measure of AMS for the Pendants may be <±0.5°C.

Table 4. Alternative Measurement Sensitivity calculated for thermistors maintained by BRWA volunteers in 2012 during pre- (4/13/12) and post- (11/27/12) deployment accuracy checks in 2012. Thermistors with "N/A" noted for the pre-deployment accuracy check were new and did not need to have an accuracy check prior to field deployment.

	4/13/2012	4/13/2012	11/27/2012	11/27/2012
Thermistor Number	AMS ice bath	AMS room temp.	AMS ice bath	AMS room temp.
9885850	0.06	0.04	0.06	0.07
9922450	0.06	0.04	0.03	0.06
9922453	0.04	0.00	0.06	0.07
10133369	N/A	N/A	0.00	0.13
10133370	N/A	N/A	0.11	0.16
10133371	N/A	N/A	0.06	0.07
9691859	0.19	0.39	0.06	0.06
9691864	0.11	0.20	0.06	0.06

BRWA Staff Thermistors – Bias: Field placement of all thermistors was according to QAPP protocol. Field thermometer check data were all within the certified accuracy for the field thermometers. None of the field check data with field thermometer indicated that any thermistors become exposed to air during their respective deployment periods and were functioning properly. The data quality objective for Bias was met.

First deployment data point and the first data point after any time the thermistor was removed from the stream during deployment were removed from temperature record for each thermistor for the purpose of data analysis (to ensure thermistor fully equilibrated with in-stream temperatures).

BRWA Volunteer Thermistors – Bias: Field placement of thermistors maintained by volunteers was the responsibility of the volunteers. All were trained on BRWA's protocol prior to receiving and deploying their thermistors. Field checks by volunteers revealed several instances where loggers were buried or exposed to air during deployment. See the discussion below in "BRWA Volunteer Thermistors Completeness" regarding how data use decisions were made data for each site with respect to its effect on capturing the maximum daily mean temperature.

BRWA Staff Thermistors – Accuracy: BRWA's NIST-traceable thermometer (Control Company CC-244) was used for the pre- and post-deployment accuracy checks. All thermistors recorded accuracy within the certified range of the TidbiT v2 thermistors (+/-0.2 °C) in both the room temperature and ice baths (Table 5). The results indicate they are all collecting good data. The data quality objective for Accuracy was met.

Table 5. Pre- (4/13/12) and Post- (11/27/12) deployment accuracy (+/-°C) check for all thermistors maintained by BRWA staff during the 2012 field season. Accuracy check was conducted according to BRWA's QAPP (Control Company CC-244 thermometer was used as the reference thermometer for all checks).

	4/13/2012	4/13/2012	4/13/2012	11/27/2012	11/27/2012	11/27/2012
Thermistor Number	Accuracy ice bath	Accuracy room temp.	Mean accuracy	Accuracy ice bath	Accuracy room temp.	Mean accuracy
9885848	0.03	0.03	0.03	0.01	0.02	0.02
9885855	0.02	0.04	0.03	0.06	0.04	0.05
9885856	0.08	0.10	0.09	0.07	0.07	0.07
9885860	0.10	0.11	0.11	0.12	0.11	0.12
9885864	0.11	0.11	0.11	0.12	0.11	0.11
9922449	0.01	0.02	0.01	0.05	0.02	0.03
9922451	0.10	0.09	0.09	0.14	0.09	0.12
9922452	0.06	0.08	0.07	0.11	0.09	0.10

BRWA Volunteer Thermistors– Accuracy: BRWA's NIST-traceable thermometer (Control Company CC-244) was used for the pre- and post-deployment accuracy checks. All thermistors recorded accuracy within the certified range of the TidbiT v2 thermistors (+/-0.2 °C) and Pendant (UA-002-64) thermistors in both the room temperature and ice baths (Table 6). The results indicate they were all collecting good data. The data quality objective for Accuracy was met.

Table 6. Pre- (4/13/12) and Post- (11/27/12) deployment accuracy (+/- °C) check for all thermistors maintained by BRWA volunteers during the 2012 field season. Accuracy check was conducted according to BRWA's QAPP (Control Company CC-244 thermometer was used as the reference thermometer for all checks). Thermistors with "N/A" noted for the pre-deployment accuracy check were new and did not need to have an accuracy check prior to field deployment.

	4/13/2012	4/13/2012	4/13/2012	11/27/2012	11/27/2012	11/27/2012
Thermistor Number	Accuracy ice bath	Accuracy room temp.	Mean accuracy	Accuracy ice bath	Accuracy room temp.	Mean accuracy
9885850	0.06	0.07	0.06	0.09	0.08	0.09
9922450	0.01	0.05	0.03	0.03	0.05	0.04
9922453	0.01	0.02	0.01	0.02	0.01	0.01
10133369	N/A	N/A	N/A	0.07	0.08	0.07
10133370	N/A	N/A	N/A	0.04	0.07	0.05
10133371	N/A	N/A	N/A	0.09	0.09	0.09
9691859	0.25	0.25	0.25	0.29	0.27	0.28
9691864	0.21	0.15	0.18	0.19	0.21	0.20

BRWA Staff Thermistors – Representativeness: All thermistors were deployed prior to June 1 and retrieved after September 15. All sites had at least four months of data collected. Therefore, the thermistors were likely to have captured the maximum daily mean temperature (MDMT) at each site and the representativeness data quality objective was met.

BRWA Volunteer Thermistors – Representativeness: The representativeness data quality objective was not met for some sites. See discussion under "BRWA Volunteer Thermistors – Completeness" for details and site-specific recommendations.

BRWA Staff Thermistors – Comparability: TidbiT v2 thermistors were used at all sites. These models are frequently used by WDNR.

BRWA Volunteer Thermistors – Comparability: TidbiT v2 or Pendant (UA-002-64) thermistors were used at all sites. These models are frequently used by WDNR.

BRWA Staff Thermistors – Completeness: Completeness equals the total number of thermistors deployed that are retrieved and produce usable data divided by the total number of thermistors deployed times 100 [((8 /10)* 100) = 80%]. The data quality objective of 90% was not met. Two thermistors were lost due to a wire shearing off the deployment housing. These sites were the Tyler Forks River at Caroline Lake Rd and the Potato River at Upson Park (Table 1). We recommend using a thicker gauge wire for future deployments.

BRWA Volunteer Thermistors – Completeness: Completeness equals the total number of thermistors deployed that are retrieved and produce usable data divided by the total number of thermistors deployed times 100 [((8 /9)* 100) = 89%]. The data quality objective of 90% was not met. One thermistor was lost (unknown cause) from Schramm Creek at Monshine Alley. We recommend using the same deployment housing in future years, but emphasizing use of a strong anchor point during volunteer training.

There are several notes regarding data completeness and the volunteer thermistors. Two large storm events (one on 5/25/12 yielded over 2.5 in of rain and one on 6/20/12 yielded over 3 in of rain) in the Ashland area resulted in some thermistors getting buried under sediment. The following describes these scenarios for each affected site and gives a recommended decision on use of data:

1. City Creek at Jokinen Rd., BRWA site#9003 – This logger showed evidence in the temperature record of being buried following the 6/20/12 storm until the volunteer checked the logger on 7/25/12 and noted it was buried in debris. Recommend not using data between midnight on 6/20/12 and 8:00pm on 7/25/12. This logger was likely buried during the period of time when the maximum daily mean temperature would have occurred, so recommend not using data for that purpose. No data from this site were sent to WDNR.
2. Hawkins Creek at Snake Trail Rd., BRWA site #598 –The temperature record from this site looked good except on 8/18/12 there was a sharp drop in temperature during mid-day and then recovery to temperatures consistent with surrounding dates and with recorded air temps from Ashland. No evidence of data problems exist outside of this anomaly so the decision was to remove 8/18/12 data. This won't impact calculation of the maximum daily mean temperature from this site. This thermistor was deployed on 6/12/12, past the QAPP deadline of 6/1. Based on data recorded from other sites in 2012, the maximum daily mean likely occurred in the early part of July 2012, so the 2012 data record from this site likely captured the maximum daily mean temperature and is useable for that purpose.

3. Freburg Creek at Freburg Rd, BRWA site#1019 – The volunteer had indicated the thermistor was buried when she made one of her field visits. Communication with the volunteer revealed that the thermistor housing was buried and not the thermistor itself. The data record for this site looks good and is useable for calculating the maximum daily mean temperature.
4. Gehrman Creek at Popko Rd, BRWA site #888 – This thermistor was deployed on 6/25/12, well past the QAPP deadline of 6/1. Despite this and based on data recorded from other sites in 2012, the maximum daily mean temperature likely occurred in the early part of July 2012. The 2012 data record from this site likely captured the maximum daily mean temperature and is useable for that purpose.
5. Unnamed Brunsweiler Trib at Hwy C, BRWA site #140 – There were two instances where the volunteer indicated the thermistor was buried during field checks. Both of these checks followed the significant rain events that occurred in May and June 2012. As a result, data from midnight on 5/24/12 until 5/25/12 at 3:00pm and from midnight on 6/20/12 until 6/25/12 at 8:00pm were removed from the dataset for the purposes of calculating maximum daily mean temperature. Despite this and based on data recorded from other sites in 2012, the maximum daily mean temperature likely occurred in the early part of July 2012. The 2012 data record from this site likely captured the maximum daily mean temperature and is useable for that purpose.
6. Broeniman Creek at Broeniman Rd, BRWA site #115 – The volunteer indicated the thermistor was partially buried during a field check on 7/12/12. After reviewing the data, the thermistor was likely recording the water temperature and not buried under sediment. The 2012 data record from this site likely captured the maximum daily mean temperature and is useable for that purpose.
7. Silver Creek at Hwy 13, BRWA site #200 – This thermistor was deployed on 6/13/12, past the QAPP deadline of 6/1. The thermistor was likely buried between midnight on 6/20/12 and 1:50pm on 6/25/12. The thermistor was found lying on the shore of the stream in late summer 2012 by a volunteer and shows evidence of being exposed to air after midnight on 7/9/12. The available data from this site are very limited but should be useful to give a reasonable indication of the 2012 maximum daily mean temperature since it likely occurred in early July 2012 at most other sites.

Macroinvertebrates

Data Quality Indicators from QAPP:

Precision, Accuracy, and Bias:

The multi-habitat method of collecting macroinvertebrates does not support quantitative precision, accuracy, or bias calculations. Instead, two qualitative methods were used to assess these parameters.

To ensure accuracy and minimize bias, BRWA worked with Dr. Kurt Schmude, Aquatic Entomologist with the University of Wisconsin-Superior Lake Superior Research Institute (LSRI) Taxonomy Laboratory. Dr. Schmude and his lab conducted all sample processing and analysis according to their established

protocols (Appendix D of BRWA's QAPP). BRWA Project Managers received training in proportional, multi-habitat sampling techniques from Dr. Schmude prior to sampling conducted in fall 2011.

Precision of the method was assessed by collecting duplicate macroinvertebrate samples at a single site, one each by two BRWA Project Managers, and looking at the relative percent difference (RPD) between all calculated indices for both samples. The duplicate sample was collected on 5/2/2012 from Taylor Forks at Highway 77. The target value for the RPD between the duplicate samples is less than 40%. This RPD expectation is larger for macroinvertebrates than for analytical chemistry due to the large variability in natural macroinvertebrate communities.

The resulting RPD values for indices calculated by the Wisconsin Department of Natural Resources Surface Water Integrated Monitoring System (SWIMS) for the duplicate samples were well within the 40% goal (Table 7). The RPD calculation results indicate good precision between duplicate samples collected with the proportional, multi-habitat method by different people.

Table 7. Relative Percent Difference (RPD) between various indices calculated from duplicate macroinvertebrate samples collected from Tyler Forks at Highway 77 by two BRWA Project Managers.

Index Type	BRWA Project Manager 1	BRWA Project Manager 2	RPD (%)
Hilsenhoff's Biotic Index (HBI)	4.2	4.1	2.4
HBI Max 10	4.1	4.2	2.4
Family-level Biotic Index (FBI)	5.2	5.3	1.9
Shannon's Diversity Index	5.2	4.8	8.0
Species Richness = taxa richness	74	57	26.0
Genera Richness	68	53	24.8
Percent EPT Genera	26	30	14.3
Percent EPT Individuals	20	22	9.5
Index of Biotic Integrity (IBI)	10.0	10.2	2.0

Representativeness: The multi-habitat sampling method, as outlined in the QAPP, is considered to allow a representative sample of the stream community as a whole. The method was followed for all samples.

Comparability: All samples were collected and analyzed using methods described in BRWA's QAPP for this project. Dr. Kurt Schmude also analyses macroinvertebrate samples for WDNR projects.

Completeness: A sample was collected from all sites selected for this project and analyzed according to data quality objectives established in the QAPP. Data quality objective of 100% Completeness was met.