

Quality Control Report

Bad River Watershed Association's (BRWA) 2013 "Staff Baseline Water Quality Monitoring Near the Potential Penokee Iron Ore Mine - Continuous Temperature"

Authored By:

Cynthia Glase Cynthia Glase Date: 5/5/2014
Private Contractor

Joan Elias Joan Elias Date: 5/4/2014
Aquatic Ecologist
National Park Service, Retired

Independent Review Conducted By:

Tracey Ledder Tracey Ledder Date: 5/10/2014
Technical Advisor, Bad River Watershed Association
Monitoring Coordinator, Lake Superior Estuarine Research Reserve

Summary

This Quality Control 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." The report includes results of quality assurance tests pre- and post-field season, and notes any changes in methodology or quality control that occurred during the course of project implementation (see "Deviations").

During 2013, a private contractor working with BRWA, along with BRWA staff and volunteers, deployed, maintained, and retrieved 13 thermistors as part of BRWA's continuous temperature monitoring program. Temperature and water quality data were collected monthly by the private contractor at eight of the 13 sites (Table 1). In 2013, five thermistors were deployed, maintained, and retrieved by volunteers (Table 2). The private contractor visited each of the five volunteer sites once during the season to check the status of the thermistors. No conductivity measurements were taken in 2013 due to lack of personnel and funding.

Volunteers were responsible for deploying thermistors, conducting field checks, and retrieving their thermistors using the same protocol as BRWA staff. The private contractor conducted all quality control testing of the volunteer thermistors, as described in the staff QAPP, and managed all temperature data.

Macroinvertebrate samples were collected at five sites on 10/7/2013 by BRWA staff and volunteers consisting of federal employees with biological field experience. All participants were trained by Valerie Damstra, former BRWA employee who conducted macroinvertebrate sampling previously.

Some changes in locations of BRWA's temperature and macroinvertebrate monitoring sites occurred in 2013. Through collaboration with our partners in the region, we identified new sites for which no data existed and data were desirable. BRWA added some of these sites to our monitoring efforts in 2013. Some sites were repeated, in order to learn more about the natural range of variation. Some sites monitored by BRWA previously were monitored by others; BRWA dropped them in 2013 so as not to duplicate efforts. Some sites were dropped simply due to lack of personnel and funding and we deemed it more important to collect data from new sites. Most of the sites that were dropped from this protocol were sampled for macroinvertebrates by volunteers in 2013, with identification taken to the family level. Table 1 shows the locations of temperature and macroinvertebrate sampling in 2013.

Deviations

BRWA's QAPP recommends using 10 measurements for the calculation of Alternate Measurement Sensitivity (AMS). Ten measurements were used when possible. However when we noticed that the temperature of the ice bath had not yet stabilized and some thermistors failed the quality assurance requirement because of that, we eliminated the first three measurements and used seven measurements for the calculation. While 10 measurements are preferable for calculating AMS, seven measurements are adequate.

Significant Quality Assurance Problems and Recommended Solutions

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

The thermistor at one volunteer site (Bull Gus Creek at FR 703) was deployed too late in the season to use the data for calculation of maximum daily mean. The data recorded are useable for other purposes, and should be part of the record in the SWIMS database as long as maximum daily mean temperature is not calculated and included in the database.

Review of the macroinvertebrate data in the SWIMS database indicates a sampling date in error. The unnamed tributary to Rouse Creek at Casey Sag Road (SWIMS ID #10034372, BRWA site # 2022, lat/long coordinates 46.36097 90.4658) should have a sampling date of 10/7/2013 rather than 10/6/2013.

Table 1. Sites monitored for continuous temperature by Bad River Watershed Association contractor (C) and volunteers (V) during 2013 near the site of a potential open-pit iron ore mine between Mellen and Hurley, WI. Site coordinates are given in decimal degrees (DD).

Basin	River	Site Name	Macro-invertebrate Site	Temperature Site	Longitude	Latitude
Tyler Forks	Erickson	Casey Sag Rd.	V	C	-90.465233	46.372039
Tyler Forks	Rouse	Casey Sag Rd.		C	-90.465767	46.360833
Tyler Forks	Unnamed tributary to Rouse	Casey Sag Rd.	V	C	-90.46569	46.36098
Upper Bad	Bad River	Gilman Park		V	-90.663220	46.322920
Upper Bad	Ballou	Red House Rd.	V	C	-90.575977	46.305917
Upper Bad	City Crk	Lake Dr.		C	-90.644975	46.308677
Upper Bad	Devils Cr	Hwy 77		V	-90.651860	46.321294
Tyler Forks	Unnamed Tyler Forks Tributary	FR 703	V	C	-90.501528	46.290863
Upper Bad	Opergard	Revai Rd.		C	-90.586017	46.341617
Potato	Apple Crk	O'Brien Lake Rd.		V	-90.40246	46.34777
Upper Bad	Montreal Crk	County Line Rd.		C	-90.54869	46.35599
Tyler Forks	Bull Gus	FR 703		V	-90.505998	46.303056
Marengo	Trout Brook	Quarry Rd.		V	-90.76319	46.32740
Tyler Forks	Tyler Forks	Moore Park Rd.	V		-90.489572	46.337800

Suggestions for Future Improvements

The glass contacts on two Hobo Tidbits broke off of the thermistor housing while attempting to download data in the field with the waterproof shuttle assembly. Although not caused by mishandling, the breakage was likely caused by weakening of the glass contacts over time from multiple deployments. To lengthen the life of the Hobo Tidbits, we recommend using extreme care when connecting and disconnecting the tidbits to the waterproof shuttle, as well as properly securing the tidbit upon deployment so that stream currents do not allow the tidbit to move inside the PVC housing. We also recommend that tidbits be visually examined prior to deployment for cracks on the glass contacts.

Recommendations were made in 2012 for checking thermistors more frequently following rain events in efforts to avoid prolonged periods of time when thermistors may be buried and not recording stream temperatures; this should be continued during future deployments.

Continuous Temperature

Data Quality Indicators from QAPP

Thermistors – Alternative Measurement Sensitivity (AMS): Each thermistor was used to take 10 measurements of a water bath at room temperature and in an ice bath near 0°C, both prior to and after the field season. The standard deviation of these ten measurements was used to calculate AMS, with the optimum AMS target being $\leq \pm 0.2^\circ\text{C}$, as stated in BRWA's QAPP (Table 3). The data quality objective for AMS was met for seven of the 15 thermistors used in field season 2013. The other eight thermistors did not meet the optimum target AMS for the pre-season ice bath test. After reviewing the data we noticed that the ice bath temperatures were not stabilized for the first few readings. We then re-calculated the AMS, excluding the first three unstable readings. The recalculated AMS for these eight thermistors met BRWA's QC requirements of $< \pm 0.2^\circ\text{C}$, though the calculation used seven measurements instead of 10, as recommended by the QAPP.

Table 3. Alternative Measurement Sensitivity calculated for thermistors for the field season 2013 during pre- (5/20/13) and post- (12/9/13) deployment accuracy checks.

Site Name	Thermistor Number	Volunteer (V) or Contractor (C)	AMS ice bath Pre test	Recalculated AMS ice bath Pre test**	AMS room temp. Pre test	AMS ice bath Post test	AMS room temp. post test
Erickson Creek	9885848	C	0.000		0.000	0.135	0.033
¹ Trout Brook	9885850	V	0.364	0.082	0.000	0.161	0.038
Unnamed Rouse Trib	9885855	C	0.047		0.000	0.155	0.000
¹ Bad River	9885856	V	0.410	0.168	0.000	0.145	0.040
Rouse Creek	9885864	C	0.047		0.000	0.123	0.025
¹ Unnamed Tyler Fks Trib	9922449	C	0.566	0.124	0.000	0.112	0.025
¹ Montreal Creek	9922450	C	0.480	0.116	0.000	0.146	0.000
*City Creek	9922451	C	0.000		0.000	na	na
¹ City Creek	10133369	C	0.442	0.101	0.000	0.144	0.000
*Opergard Creek	9922452	C	0.038		0.000	na	na
Opergard Creek	10133375	C	0.047		0.033	0.246	0.000
¹ Ballou Creek	9922453	C	0.599	0.157	0.000	0.171	0.025
¹ Apple Creek	10133370	V	0.459	0.077	0.040	0.138	0.000
¹ Devils Creek	10133371	V	0.448	0.126	0.025	0.146	0.025
Bull Gus	10133373	V	0.044		0.000	0.175	0.000

¹Indicates that the AMS was recalculated using 7 measurements after failing to meet QAPP requirements using 10 measurements. All thermistors met the objectives for AMS after recalculation.

*Thermistors 9922451 and 9922452 broke while being removed from the portable shuttle in the field. Thermistors could not be re-tested in the post calibration tests.

** A blank in this column indicates that the AMS met the QAPP requirements using 10 measurements and did not require recalculation.

Thermistors – Bias: Field placement of all thermistors was according to QAPP protocol. At least three times during the season, temperature measurements recorded by the thermistors were compared with a field hand-held thermometer. Three of the 13 monitoring sites did not meet the data quality objective for Bias as outlined in the QAPP. The mean difference between field thermometer and thermistor temperature readings was not within the certified accuracy of the field thermometer (\pm one scale division, or 0.5°C). However, none of the

field check data measured with the field thermometers indicated that any thermistor was exposed to air. The sites where the field thermometer temperature was higher than the thermistor data during one or more field check were:

- Unnamed Tyler Forks Trib at FR 703, site # 2019 (upon retrieval, 10/9/2013, 13.5°C vs. 11.783°C)
- Apple Creek at O'Brien Lake Rd, BRWA site #2021 (upon retrieval, 10/3/2013, 14.0°C vs. 12.896°C)
- Bull Gus at FR 703, BRWA site #32 (8/20/2013, 18.5°C vs. 17.582°C; 10/3/2013, 13°C vs. 11.807°C)

The data quality objective for Bias was met for the remaining 10 monitoring sites. 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.

It is likely that the temperature differences resulted from not allowing field thermometers to stabilize for 2 minutes prior to reading, as suggested in the QAPP and SOP. Despite data quality objectives not being met for bias at the sites mentioned above, the placement of the thermistors and remaining field checks indicate that the data are still usable and reliable. Additionally, the post-season accuracy tests (see below) indicate all thermistors functioned properly throughout the season.

Thermistors – Accuracy: A NIST-traceable thermometer (Control Company CC-244) was used for the pre- and post-deployment accuracy checks. The pre-season accuracy checks were performed with NIST thermometer Serial # 111701324, with a certification expiration date of 7/28/13. Since the certification expired prior to the end of the field season, BRWA purchased a new NIST thermometer, Serial # 130514523, expiration date 9/5/15, which was used to perform the post-season accuracy tests. 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 4). The data quality objective for Accuracy was met.

Contractor Thermistors – Representativeness: Thermistors at six of the 13 temperature monitoring sites were deployed prior to June 1 and retrieved after September 15, meeting QAPP requirements. However, due to late spring storms causing high stream flows and making access to temperature monitoring sites difficult and dangerous, seven sites were deployed after June 1, 2013. Despite the late deployment dates, 10 of the 13 temperature monitoring sites had at least four months of data collected. Sites #2021 (Apple Creek), #785 (Bad River), and #32 (Bull Gus) did not meet the four month minimum deployment as outlined in the QAPP. The following thermistors were deployed past the QAPP deadline of June 1, 2013:

Contractor sites:

- Montreal Creek at County Line Rd, BRWA site #809 – deployed on 6/2/13
- Ballou Creek at Redhouse Rd, BRWA site #869 – deployed on 6/2/13

Volunteer sites:

- Apple Creek at O'Brien Lake Rd, BRWA site #2021 – deployed on 6/15/13
- Bull Gus at FR 703, BRWA site #32 – deployed on 7/11/13
- Trout Brook at Quarry Rd, BRWA site #921 – deployed on 6/5/13
- Bad River at Gilman Park, BRWA site #785 – deployed on 6/12/13
- Devils Creek at Hwy 77, BRWA site #2010 – deployed on 6/12/13

Table 4. Pre- (5/20/13) and Post- (12/9/13) deployment accuracy (+/-°C) check for all thermistors maintained by BRWA contractor and volunteers during the 2013 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).

Site Name	Thermistor Number	Volunteer (V) or Contractor (C)	Accuracy ice bath Pre- test	Accuracy room temp Pre- test	Accuracy ice bath Post- test	Accuracy room temp Post- test
Erickson Creek	9885848	C	0.03	0.05	0.11	-0.01
Trout Brook	9885850	V	0.12	0.09	0.12	0.03
Unnamed Rouse Trib	9885855	C	0.06	0.07	0.10	-0.01
Bad River	9885856	V	0.18	0.09	0.14	0.03
Rouse Creek	9885864	C	0.15	0.12	0.19	0.07
Unnamed Tyler Fks Trib	9922449	C	0.14	0.05	0.05	-0.03
Montreal Creek	9922450	C	0.12	0.07	0.11	0.02
*City Creek	9922451	C	0.15	0.12	NA	NA
City Creek	10133369	C	0.17	0.09	0.2	0.04
*Opergard Creek	9922452	C	0.09	0.09	NA	NA
Opergard Creek	10133375	C	0.12	0.09	0.21	0.04
Ballou Creek	9922453	C	0.12	.02	.07	-.03
Apple Creek	10133370	V	.12	.08	.13	.02
Devils Creek	10133371	V	.15	.10	.16	.04
Bull Gus	10133373	V	.15	.14	.23	.09

*Thermistors 9922451 and 9922452 broke while being removed from the portable shuttle in the field, therefore thermistors could not be re-tested in the post calibration tests.

Based on temperature data recorded from other sites in 2013, the maximum daily mean temperatures likely occurred in the middle of July 2013. The 2013 data records from all sites, with the exception of the Bull Gus at FR 703, likely captured the maximum daily mean temperatures (MDMT) and are useable for that purpose.

The Bull Gus monitoring site was a late addition to BRWA's site list and had a late deployment date. After comparison with another site (Unnamed Tyler Forks Trib at FR703, BRWA site #2019), which is located near the Bull Gus site, it is possible that we may have missed the maximum daily mean temperature. The data from the Unnamed Tyler Forks Tributary recorded a maximum daily mean temperature on 6/25/13, deviating from the mid-July high temperatures that most other monitoring sites recorded. Based on flow readings from the USGS gage recordings at Tyler Forks at Stricker Rd., this high temperature on 6/25/13 could have been caused by a warm rain event that may have impacted the Bull Gus Creek site as well. The Bull Gus Creek data were included in the data submitted to WI DNR.

Additionally, BRWA site #921, Trout Brook at Quarry Rd, recorded peak temperatures that were substantially higher than peak temperatures in other monitored streams. This temperature logger recorded stream temperatures in the range of 27.5°C and slightly exceeding 28°C on July 17 and July 18. These high water temperatures were suspect until further investigation showed that site location and rain events may have contributed to these temperatures. The monitoring site was located adjacent to a road that has new black-top. The newly paved road proceeds upstream approximately 300 to 450 ft with an uphill grade, perhaps influencing water temperatures with warm rain runoff. According to the volunteer monitoring this site, all visible water

seems to come from two water impoundments caused by the location of an old quarry, which could also result in increased temperatures. It remains uncertain if there are any natural springs that feed into the quarry. The volunteer assured that the temperature logger was not exposed to air. The maximum daily mean temperature at most of the other monitoring sites also occurred on July 17th and 18th. Therefore, the timing of the peak temperatures in Trout Brook corresponded with peak temperatures in other monitoring sites and should be considered accurate and usable for calculating the maximum daily mean temperature.

The following sites had partially buried thermistors from sand and or debris discovered during field checks on the dates noted below. After reviewing the data, the thermistors at all of those sites were likely recording the water temperature and not the sediment. The 2013 data record from these sites likely captured the maximum daily mean temperatures and is useable for that purpose.

- City Creek at Lake Drive, BRWA site #829 – 10/9/10 (date of retrieval)
- Unnamed Tyler Forks Trib at FR 703, BRWA site #2019 – 10/9/13 (date of retrieval)
- Montreal Creek at County Line Rd, BRWA site #809 – 7/29/13
- Erickson Creek at Casey Sag Rd, BRWA site #17 – 10/4/13 (date of retrieval)

To summarize, 10 of 13 sites had at least four months of data collected, meeting the QAPP objective. After comparison of thermistor data, there is sufficient evidence that the maximum daily mean temperatures were captured for 12 of the 13 monitoring sites. Maximum daily mean temperatures likely occurred in mid-July, allowing data from 12 of the 13 monitoring sites to be usable for that purpose. The exception is Bull Gus at FR 703; data collected at this site are acceptable but should not be used for calculating maximum daily mean temperature.

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

Contractor 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 $(((8 / 8) * 100) = 100\%)$. The data quality objective is > 90%, as outlined in BRWA's QAPP and was subsequently met.

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 $(((4 / 5) * 100) = 80\%)$. The data quality objective of >90% was not met. The discussion of sites deviating from the data quality objectives in BRWA's QAPP is outlined above. The Bull Gus at FR 703 site as the only temperature monitoring site not inclusive in producing usable data, perhaps missing the maximum daily mean temperature.

Contractor and 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 $(((12 / 13) * 100) = 92\%)$. The data quality objective is > 90%, as outlined in BRWA's QAPP and was met when combining all 13 thermistors deployed in field season 2013.

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, qualitative methods were used to assess these parameters.

To ensure accuracy and minimize bias, BRWA again 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. One of these Project Managers (Valerie Damstra) trained volunteers in 2013 prior to sampling. Volunteers were either BRWA staff members or federal employees with biological field expertise.

Precision of the method was not assessed in 2013.

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 analyzes macroinvertebrate samples for WDNR projects.

Completeness: Complete samples were collected at five sites and analyzed according to data quality objectives established in the QAPP. Data quality objective of 100% Completeness was met.