Quality Control Report

Bad River Watershed Association's (BRWA) 2011 "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."

Overall, data quality objectives for continuous temperature, macroinvertebrate, and conductivity data were met for BRWA's 2011 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.

It should be noted that this QAPP was being developed and approved during completion of field and laboratory data collection activities in 2011. The QAPP was developed in order to document the systematic planning that occurred and methods used for collecting and evaluating data for BRWA's project. This report notes any changes in methodology or quality control that occurred during the course of project implementation (see "Deviations").

Deviations:

Data quality objectives for conductivity monitoring (section A7 of the QAPP) were updated during the course of the 2011 field season (added a low conductivity check standard). The update and impact on the project are discussed in the attached Deviation Form. Overall this update is seen as an improvement to documenting performance of the conductivity meter, but does not change the usability of data collected during 2011. Future data collection using the low check standard will improve ability to evaluate meter performance at low conductivity values.

Significant Quality Assurance Problems and Recommended Solutions:

There were no significant quality assurance problems identified during field or laboratory activities associated with this project.

Suggestions for Future Improvements:

1. More frequent conductivity measurements to establish baseline – The frequency and duration of conductivity data collection could be increased in order to improve baseline, depending on the level of detail desired to evaluate pre-mining stream conditions. Collecting continuous conductivity measurements with a data logger deployed for a year or longer is one option that partners have used in some sites in the area. Another option would be to collect monthly conductivity data annually over the course of multiple years (BRWA uses 4 years to establish baseline with other portions of its water monitoring activities).

2. Collect macroinvertebrate data in future years during both spring and fall – Macroinvertebrate data exhibit a considerable amount of natural variability both temporally and spatially, so sampling the macroinvertebrate community in spring and fall will provide a more complete picture of taxa present at these sites.

3. Conduct side-by-side macroinvertebrate sampling with Wisconsin Department of Natural Resources (WDNR) staff – This should be done to provide a comparison between the single-riffle habitat sampling method used by WDNR and the multi-habitat method used by BRWA for this study. Many of the metrics calculated (such as the HBI, FBI, and IBI [see Table 1]) were designed for use with single-riffle habitat sampling methods utilized by WDNR. Interpretation of these metrics needs to be made with caution, particularly when using them with the multi-habitat collection method. A macroinvertebrate data interpretation manual available from WDNR provides considerable discussion about limitations and considerations that need to be made when interpreting macroinvertebrate data (Lillie et al. 2003). Comparison of the two methods and results obtained with both will aid in interpretation of BRWA data and provide more data for establishing a baseline of macroinvertebrate communities present in streams near the potential iron mine site prior to any mining activities.

4. Adjust data quality objective for continuous temperature bias, in Table 3 of the QAPP. Change data quality objective to: “Difference between field thermometer and thermistor measurements greater than certified accuracy for field thermometer in fewer than two consecutive field check measurements.” Adjust corrective action related to this data quality objective to: “Flag data and evaluate thermistor and field thermometer in post-field deployment accuracy check to see if adjustment to thermistor data should be made (see section B7 for corrective action discussion).”

5. Update “BRWA Field Sheet for Continuous Temperature Thermistors” in Appendix A of the QAPP “Standard Operating Procedure (SOP): Bad River Watershed Association Staff Continuous Temperature Monitoring” to include a column to document whether the red light on the thermistors blinked every 4

seconds with each field check. Also add this additional check to page 5 (section J, number 4) of the Continuous Temperature SOP.

Continuous Temperature

Data Quality Indicators from QAPP:

Alternative Measurement Sensitivity (AMS): Calculations for all thermistors used in the field in 2011 were <±0.2°C for both the pre- and post-deployment accuracy checks. The data quality objective for AMS was met (Table 1).

Table 1. Alternative Measurement Sensitivity calculated for all thermistors during pre- (5/12/11) and post- (12/16/11) deployment accuracy checks during 2011.

	5/12/2011	5/12/2011	12/16/2011	12/16/2011
Thermistor Number	AMS ice bath	AMS room temp.	AMS ice bath	AMS room temp.
9885848	0.00	0.00	0.00	0.08
9885850	0.03	0.00	0.00	0.06
9885852	0.03	0.00	0.00	0.06
9885854	0.04	0.02	0.03	0.08
9885856	0.03	0.00	0.00	0.08
9885864	0.04	0.00	0.00	0.08
9885865	0.00	0.00	0.00	0.06
9922449	0.00	0.00	0.00	0.08
9922450	0.00	0.00	0.03	0.08
9922451	0.04	0.00	0.00	0.08
9922452	0.05	0.03	0.05	0.08
9922453	0.04	0.00	0.05	0.07

Bias: Field placement of all thermistors was according to QAPP protocol. 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 removed from temperature record for each thermistor for the purpose of data analysis (to ensure thermistor fully equilibrated with in-stream temperatures).

Notes on field checks of thermistors – The data quality objective is that the mean difference between field thermometer and thermistor temperature readings should be within the certified accuracy of the field thermometer. The purpose is to provide a qualitative check of whether the thermistors are recording consistent data or if there is evidence the instruments are not functioning properly and adjustments should be made to the thermistor data. The timing of the field temperature measurements did not always match up with the timing of the programmed thermistor temperature measurements

(field thermometer measurements were within a half hour or less of each thermistor reading), preventing direct comparisons between the two measurements. However, looking at the thermistor temperature trend before and after the field thermometer measurement was taken allowed the reviewer to get a good sense if the field thermometer and thermistor were giving similar readings. There were 3 instances where the difference between the field thermometer and thermistor readings was greater than the certified accuracy of the field thermometer, but these were all cases where the timing of the measurements did not line up. Extrapolation of the thermistor temperature trend at the time indicated the readings probably would have been within the field thermometer certified accuracy if taken at the same time. Because this is a qualitative check of the thermistors, a better way to evaluate the field temperature readings compared to the thermistor temperature readings would be to flag any difference in field readings greater than the certified accuracy of the field thermometer and then evaluate those instances for systematic evidence that the thermistor was not functioning properly and whether a temperature adjustment with the results needs to be made. This should be done as part of the post-field deployment accuracy check of the thermistors and field thermometers. Corrective actions related to the post-deployment accuracy checks are discussed in section B7 of the QAPP. Overall, no problems were noted with the 2011 data.

All field records indicate that all thermistors were functioning properly (as evidenced by a blinking red light) at each field check and data download during the 2011 deployment period. However, one thermistor (9922451) did not record temperature data between 9/29 and the retrieval date of 11/14/11. Because the thermistor collected data over the time period most likely to include the maximum daily mean temperature (June through August), this will not present a problem for data analysis. In the future, field notes on whether thermistors are functioning properly should indicate that the blinking red light occurs at the proper interval to indicate data are being collected (4 seconds). Also, downloading data to a laptop immediately in the field will help give an indication if a logger stops working or is inadvertently stopped during data download. A laptop was not always available during the 2011 season, but could be in future years.

Accuracy: Pre-deployment thermistor accuracy check – The reference thermometer used was the National Park Service's (NPS) glass and mercury thermometer graduated in 0.1 deg. C increments. Current NIST certification was unknown. This does not present a problem because all thermistors deployed in 2011 were brand new and came with available NIST certification. The check was done primarily to gain familiarity with the accuracy check method. All thermistors recorded accuracy within the certified range (compared to the NPS reference thermometer, Table 2).

Post-deployment thermistor accuracy check – One NIST-traceable thermometer was purchased prior to the post-check (Control Company CC-244). All thermistors recorded accuracy within the certified range of the thermistors (+/-0.2 degrees C) in both the room temperature and ice baths (Table 2).

Overall accuracy – All thermistors recorded accuracy within the certified range both pre-and post-deployment and for overall mean accuracy. Indicates they are all collecting good data. The data qualilty objective for Accuracy was met.

Representativeness: Field placement of 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.

Comparability: TidbiT v2 thermistors were used at all sites. Same model as frequently used by WDNR.

Completeness: [Total number of thermistors deployed that are retrieved and produce usable data ***9*** / total number of thermistors deployed ***9***] * 100 = 100%. Data quality objective of 90% was met.

Table 2. Pre- (5/12/11) and Post- (12/16/11) deployment accuracy (+/- degree Celsius) check for all thermistors used during the 2011 field season. Accuracy check was conducted according to BRWA's QAPP (NPS thermometer used 5/12/11, Control Company CC-244 thermometer used 12/16/2011.).

	5/12/2011	5/12/2011	5/12/2011	12/16/2011	12/16/2011	12/16/2011
Thermistor Number	Accuracy ice bath	Accuracy room temp.	Mean accuracy	Accuracy ice bath	Accuracy room temp.	Mean accuracy
9885848	0.1	0.1	0.1	0.0	0.0	0.0
9885850	0.1	0.1	0.1	0.1	0.1	0.1
9885852	0.1	0.1	0.1	0.0	0.1	0.1
9885854	0.0	0.0	0.0	0.1	0.0	0.0
9885856	0.1	0.1	0.1	0.1	0.1	0.1
9885864	0.1	0.1	0.1	0.1	0.1	0.1
9885865	0.2	0.2	0.2	0.2	0.2	0.2
9922449	0.1	0.1	0.1	0.0	0.1	0.0
9922450	0.1	0.1	0.1	0.0	0.1	0.0
9922451	0.1	0.1	0.1	0.1	0.1	0.1
9922452	0.1	0.1	0.1	0.1	0.1	0.1
9922453	0.0	0.0	0.0	0.0	0.0	0.0

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). In addition, BRWA Project Managers received training in proportional, multi-habitat sampling techniques from Dr. Schmude (occurred on 9/19/2011).

Precision was assessed by collecting duplicate macroinvertebrate samples, one by BRWA Project Managers and one by Dr. Schmude, and looking at the relative percent difference (RPD) between all calculated indices for both samples. The duplicate sample was collected on 9/19/2011 from BRWA site number 864 (Ballou Creek at Upstream Devils Confluence). The target value for the RPD between the duplicate samples is less than 40%. Results of duplicate analyses were to be evaluated to determine if the 40% RPD is appropriate or if additional variability or methods need to be considered to evaluate precision.

All RPD values for the duplicate samples were well within 40% except for "Percent Chironomidae Individuals" (Table 3). The Percent Chironomidae in both samples was quite small, therefore the difference appears larger. Because this family was a small percentage of both samples , this exceedance of the RPD guideline was judged to not represent a data quality problem. The RPD numbers indicate very good precision between duplicate samples collected with the proportional, multi-habitat method and the RPD threshold of 40% seems appropriate for evaluating precision for these samples. Another way to evaluate the duplicate samples could include a guideline for the total percentage of the indices that exceed 40% RPD. Such a guideline could be useful in determining whether there are consistent differences between the duplicate samples that warrant consideration when interpreting results or whether there are one or two indices that may exceed 40% RPD but do not indicate concerns with the duplicate samples as a whole (as was the case with the 2011 duplicate samples). Collecting more of these samples in the future should continue in order to provide more information to evaluate whether the technique and the 40% threshold provide good information on precision.

Table 3. Relative Percent Difference (RPD) between various indices calculated from duplicate macroinvertebrate samples collected from BRWA site number 864 by BRWA Project Managers and Dr. Kurt Schmude.

Index Type	**BRWA Project Manager**	**Dr. Kurt Schmude**	**RPD (%)**
HILSENHOFF'S BIOTIC INDEX (HBI)	2.2	2.3	7.8
HBI Max 10	2.2	2.5	13.8
FAMILY-LEVEL BIOTIC INDEX (FBI)	2.7	2.9	7.8
SHANNON'S DIVERSITY INDEX	4.4	4.6	4.8
SPECIES RICHNESS = taxa richness	43	48	11.0
GENERA RICHNESS	42	47	11.2
PERCENT EPT GENERA	48	49	2.1
PERCENT SCRAPERS	13	14	7.4
PERCENT FILTERER	16	15	6.5
PERCENT SHREDDERS	24	21	13.3
PERCENT GATHERERS	38	40	5.1
percent others (predators, etc)	9	10	10.5
PERCENT CHIRONOMIDAE INDIVIDUALS	3	6	66.7
PERCENT EPT - INDIVIDUALS	77	70	9.5
INDEX OF BIOTIC INTEGRITY (IBI)	9.2	10.1	9.5
Mean Pollution Tolerance Value	2.9	3.1	3.7
EPT taxa richness	22	25	12.8

Representativeness: All samples were collected using methods described in BRWA's QAPP for this project.

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.

Conductivity

Data Quality Indicators from QAPP:

Conductivity was measured and reported by BRWA as specific conductance. Use of the word "conductivity" refers to measurements of specific conductance in this report.

Accuracy/Bias:

1. Calibration – Successful calibration of the HI98129 instrument was performed prior to each field day (Table 2). One unsuccessful calibration occurred on 7/20/2011 after the meter electronics got wet. After drying out the electronics, the meter was successfully re-calibrated later on 7/20/2011. Data quality objective was met.
2. Calibration Checks – Calibration checks were conducted at the beginning (pre-sampling) and end (post-sampling) of each field day. Prior to the 11/14/11 field day, a deionized water blank was used as the pre-sampling check. A separate 84µS/cm calibration solution was purchased and introduced as a pre-sampling check standard on 11/14/11. This standard is closer to the expected range of stream measurements than the 1413µS/cm standard. All calibration standards and a deionized water blank were used as post-sampling check standards. All calibration checks were within the QAPP guideline for relative percent difference (within 10% of certified value) except those conducted on 11/14/11 (Table 4). Results from the deionized water blanks are displayed in Table 5. Other quality control data from 11/14/11 were within QAPP guidelines, as well as overall completeness objectives for the project (see discussion on "completeness" on page 9), but the calibration checks out of range of data quality objectives will be noted for data interpretation purposes. Further measurements with the 84µS/cm standard will determine if the HI 98129 is capable of meeting the +/- 10% quality objective to evaluate post-sampling calibration checks.
3. Bias – All blank samples (deionized water) were less than the QAPP threshold of 10µS/cm, so the data quality objective was met (Table 5).

Comparability: Comparability was assessed by taking side-by-side measurements with BRWA's HI 98129 and two conductivity instruments used by BRWA's partner, the Great Lakes Indian Fish and Wildlife

Commission (GLIFWC) and comparing the relative percent difference (RPD) between specific conductance measurements.

Side-by-side measurements were taken at four sites on 9/8/2011. All RPD values were less than the 10% data quality objective identified in BRWA's QAPP, indicating good comparability between BRWA's and GLIFWC's instruments (Table 6).

Table 4. Calibration and calibration check standard results for specific conductance (Spec. Cond.) collected during the 2011 field season.

Meter	Cal. Solution (µS/cm)	What	Date	Pre/Post Check	Spec. Cond. (µS/cm)	RPD	Cal. Success?	CalCheck Success?	Notes
HI 98129	1413	Calibration	7/20/2011	Pre			Y		
HI 98129	1413	Cal Check	7/20/2011	N/A			N		meter got wet, needs to dry out
HI 98129	1413	Cal Check	7/20/2011	N/A			Y		meter dried, cal successful
HI 98129	1413	Calibration	8/25/2011	Pre			Y		
HI 98129	1413	Cal Check	8/25/2011	Mid*	1487	5.1		Y	
HI 98129	1413	Cal Check	8/25/2011	Post	1490	5.3		Y	
HI 98129	1413	Calibration	9/8/2011	Pre			Y		
HI 98129	1413	Cal Check	9/8/2011	Post	1424	0.8		Y	
HI 98129	1413	Calibration	9/29/2011	Pre			Y		
HI 98129	1413	Cal Check	9/29/2011	Post	1425	0.8		Y	
HI 98129	1413	Calibration	10/4/2011	Pre			Y		
HI 98129	1413	Cal Check	10/4/2011	Post	1417	0.3		Y	
HI 98129	1413	Calibration	10/5/2011	Pre			Y		
HI 98129	1413	Cal Check	10/5/2011	Post	1399	1.0		Y	
HI 98129	1413	Calibration	11/14/2011	Pre			Y		
HI 98129	84	Cal Check	11/14/2011	Pre	93	10.2		N	Re-analyzed std.
HI 98129	84	Cal Check	11/14/2011	Pre	86	2.4		Y	
HI 98129	1413	Cal Check	11/14/2011	Post	1219	14.7		N	
HI 98129	84	Cal Check	11/14/2011	Post	73	14.0		N	

*Mid – This calibration check was conducted in the middle of the field day, as opposed to "pre-" or "post-" sampling.

Table 5. Blank samples measured for specific conductance (Spec. Cond.) during 2011.

Date	Time	Spec. Cond. (µS/cm)
7/20/2011	12:15	2
8/25/2011	12:38	7
8/25/2011	14:25	5
9/8/2011	9:28	0
9/8/2011	16:00	2
9/29/2011	10:32	0
9/29/2011	14:30	0
10/4/2011	10:30	0
10/4/2011	14:35	1
10/5/2011	8:15	0
10/5/2011	18:45	0
11/14/2011	12:00	0
11/14/2011	12:05	0
11/14/2011	13:14	0
11/14/2011	14:53	0

Table 6. Comparison of side-by-side specific conductance (spec. cond.) measurements taken using BRWA's HI98129 instrument and two instruments used by BRWA's partner, the Great Lakes Indian Fish and Wildlife Commission (GLIFWC). Relative percent difference (RPD) is used to compare results from the BRWA instrument compared to each of the GLIFWC instruments.

Site Number	River	Site Name	Instrument	Date	Time	Spec. Cond. (µS/cm)	RPD
889	Tyler Forks	Stricker Rd	Hanna Instruments HI 98129	9/8/2011	9:40	158	
889	Tyler Forks	Stricker Rd	GLIFWC YSI Professional Plus	9/8/2011	9:40	158	0
889	Tyler Forks	Stricker Rd	GLIFWC Hanna Instruments HI98311	9/8/2011	9:40	155	1.9
23	Javorsky Cr	Hwy 77	Hanna Instruments HI 98129	9/8/2011	11:30	134	
23	Javorsky Cr	Hwy 77	GLIFWC YSI Professional Plus	9/8/2011	11:30	131	2.3
23	Javorsky Cr	Hwy 77	GLIFWC Hanna Instruments HI98311	9/8/2011	11:30	129	3.8
26	Tyler Forks	Hwy 77	Hanna Instruments HI 98129	9/8/2011	13:00	132	
26	Tyler Forks	Hwy 77	Hanna Instruments HI 98129	9/8/2011	13:00	133	
26	Tyler Forks	Hwy 77	GLIFWC YSI Professional Plus	9/8/2011	13:00	129	3.1
26	Tyler Forks	Hwy 77	GLIFWC Hanna Instruments HI98311	9/8/2011	13:00	127	4.6
32	Bull Gus Cr	FR 703	Hanna Instruments HI 98129	9/8/2011	15:25	103	
32	Bull Gus Cr	FR 703	GLIFWC YSI Professional Plus	9/8/2011	15:25	103	0
32	Bull Gus Cr	FR 703	GLIFWC Hanna Instruments HI98311	9/8/2011	15:25	100	3.0

Representativeness: Generally 3-4 conductivity (specific conductance) measurements were taken at each site during the 2011 field season between July and November. These data are not adequate to represent the range and variability of this parameter at these sites, but they are useful in giving a preliminary sense of how the parameter compares between sites. Future data should be collected from these sites, preferably monthly for at least one year. Ideally, continuous conductivity data would be collected from these sites with BRWA's instrument used for monthly field checks. BRWA's instrument showed good comparability between partner GLIFWC's instruments, so the BRWA results can be compared to GLIFWC's results when available to see if the parameter is relatively consistent between sites in the project area. We expect conductivity to be low (<500 µS/cm) at all sites because they are in remote locations with minimal current impact from human activities.

Precision: All duplicate samples were less than 10% RPD (Table 7). The data quality objective was met.

Table 7. Duplicate specific conductance (Spec. Cond.) measurements collected during the 2011 field season.

Site Number	River	Site Name	Date	Spec. Cond. (µS/cm)	RPD
869	Ballou Cr	Red House Rd	8/25/2011	119	
869	Ballou Cr	Red House Rd	8/25/2011	119	0
889	Tyler Forks	Stricker Rd	9/8/2011	158	
889	Tyler Forks	Stricker Rd	9/8/2011	158	0
889	Tyler Forks	Stricker Rd	9/8/2011	155	1.9
23	Javorsky Cr	Hwy 77	9/8/2011	134	
23	Javorsky Cr	Hwy 77	9/8/2011	131	2.3
23	Javorsky Cr	Hwy 77	9/8/2011	129	3.8
26	Tyler Forks	Hwy 77	9/8/2011	132	
26	Tyler Forks	Hwy 77	9/8/2011	133	
26	Tyler Forks	Hwy 77	9/8/2011	129	3.1
26	Tyler Forks	Hwy 77	9/8/2011	127	4.6
32	Bull Gus Cr	FR 703	9/8/2011	103	
32	Bull Gus Cr	FR 703	9/8/2011	103	0
32	Bull Gus Cr	FR 703	9/8/2011	100	3.0
864	Ballou Cr	Upstream Devils Confluence	10/4/2011	96	
864	Ballou Cr	Upstream Devils Confluence	10/4/2011	97	1.0
2013	Opergard Cr	Off Revai Rd	10/5/2011	103	
2013	Opergard Cr	Off Revai Rd	10/5/2011	104	1.0
17	Erickson Cr	Casey Sag Rd	11/14/2011	154	
17	Erickson Cr	Casey Sag Rd	11/14/2011	154	0
869	Ballou Cr	Red House Rd	11/14/2011	61	
869	Ballou Cr	Red House Rd	11/14/2011	61	0

Alternative Measurement Sensitivity (AMS): Two AMS evaluations were done and both resulted in AMS values at or below +/- 5 µS/cm (Table 8). The data quality objective was met.

Completeness: A total of 71 quality control samples were collected during the course of the 2011 field season related to conductivity monitoring. Three of the samples (4.2%) did not meet QAPP guidelines. Since greater than 95% of quality control samples met guidelines, the data quality objective for completeness was met.

Table 8. Results from alternative measurement sensitivity evaluations conducted during the 2011 field season. Measurements are collected at a field site, one right after the other.

Date	Spec. Cond. (µS/cm)	AMS (µS/cm)
11/14/2011	73	5.0
11/14/2011	76	
11/14/2011	76	
11/14/2011	76	
11/14/2011	76	
11/14/2011	77	
11/14/2011	77	
8/25/2011	140	3.3
8/25/2011	140	
8/25/2011	140	
8/25/2011	140	
8/25/2011	140	
8/25/2011	138	
8/25/2011	141	

References:

Lillie, R. A., S.W. Szczytko, and M.A. Miller. 2003. Macroinvertebrate Data Interpretation Guidance Manual. Wisconsin Department of Natural Resources. Madison, WI. PUB-SS-965. 57 p.

Appendices:

Appendix 1. Deviation Form –Bad River Watershed Association

APPENDIX 1. DEVIATION FORM - BAD RIVER WATERSHED ASSOCIATION

Project Title: Staff Baseline Water Quality Monitoring Near the Potential Penokee Iron Ore Mine - Continuous Temperature, Macroinvertebrate, and Conductivity

Date/Time: 2011 field dates prior to 11/14/11

Explanation of Deviation: Improvements to the quality control data collected for the conductivity monitoring were made during the field season. A second check standard (84 µS/cm) was added to the calibration and calibration check procedures at the beginning and end of each field day. This standard is closer to the range of conductivity measurements encountered in the monitored streams.

Corrective Procedure: This procedure was implemented on the final field day of the 2011 season.

Signature: _____ Date: 6/1/12

Route to BRWA Project Director for Evaluation.

Impact on this Study: Minimal

The addition of the low conductivity check standard (84 µS/cm) will provide a better check of how accurately the HI 98129 conductivity meter is measuring conductivity at lower values. Prior to adding the check standard, a deionized water blank was used as a calibration check before and after each sampling day, which provided some indication of the meter's performance at low conductivity values. While adding the low check standard will improve overall quality control, data collected prior to using the low check standard can still be used, with the understanding of the method improvements made during the course of the field season. Future data collection using the low check standard will provide more information to evaluate meter performance at low conductivity values.

Signature: _____ Date: 6/20/12