1ST QUARTER 2006
AIR QUALITY AND METEOROLOGICAL MONITORING AUDIT REPORT

PREPARED FOR:

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US ENVIRONMENTAL PROTECTION AGENCY
REGION 9
REMEDIAL PROJECT MANAGER

YERINGTON/ANACONDA MINE SITE
YERINGTON, NEVADA

Prepared by

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1.0 Oversight and Audit Summary

On behalf of the US Environmental Protection Agency (EPA), Tetra Tech EM Inc. (Tetra Tech) personnel are providing ongoing regulatory support for the Yerington Mine air quality and meteorological monitoring program. Atlantic Richfield Company's (ARC) environmental contractor, Brown and Caldwell (B & C), are currently performing all aspects of this program. Tetra Tech reviewed and provided comments and feedback on the Air Quality Monitoring Work Plan for the Yerington Mine Site (AQMWP), Authored by B & C.

The AQMWP provides details on proposed actions for air quality and meteorological monitoring at the Yerington site. The air quality-monitoring component of the AQMWP includes the installation and operation of seven Hi-Volume (Hi-Vol) particulate matter less than 10 microns (PM_{10}) samplers and six Hi-Vol total suspended particulate (TSP) samplers at sample locations approved by ARC, B&C, EPA, and Tetra Tech. The meteorological monitoring component of the AQMWP includes the continued operation of an existing 10-foot meteorological tower. The air quality and meteorological monitoring parameters and instrumentation for the Yerington Mine Site are summarized in Table 1-1.

Table 1-1

Air Quality and Meteorological Monitoring Parameters for Yerington Mine Site

Parameter	Instrument Description-Model	Instrument Location
Wind Speed	RM Young Model 05305 AQ	10 feet AGL
Wind Direction	RM Young Model 05305 AQ	10 feet AGL
Ambient Temperature	Vaisala Temperature/Humidity Probe	7 feet AGL
Relative Humidity	Vaisala Temperature/Humidity Probe	7 feet AGL
Solar Radiation	Licor Model LI200X	9 feet AGL
Station Barometric Pressure Sensor	Vaisala Barometric Pressure Sensor	Meteorological Tower Enclosure Cabinet
Meteorological Tower Datalogger	Campbell Scientific CR10X	Meteorological Tower Enclosure Cabinet
PM_{10} Hi-Volume FRM Sampler	Tisch Environmental, Inc. Model TE-6070D	7 Total samplers at 6 locations
TSP Hi-Volume FRM Sampler	Tisch Environmental, Inc. Model TE-5170D	6 Total samplers at 6 locations

Table 1-1 (continued)

Notes:

AGL	Above ground level
FRM	Federal Reference Method
PM_{10}	Particulate matter less than 10 microns in diameter
TSP	Total suspended particulate

Tetra Tech personnel coordinated with B&C personnel to meet at the site and perform EPA-reference method audit procedures on seven PM_{10} samplers, six TSP samplers, and the on-site meteorological tower. PM_{10} and TSP audits were performed using a certified Hi-flow audit orifice and the meteorological tower was audited using certified reference sensors.

Mr. Doug Herlocker of Tetra Tech conducted the audit procedures at the Yerington site on January 9 through 10, 2006. The following tasks were performed:

- EPA and manufacturer-approved audit of seven PM_{10} Hi-Vol and six TSP Hi-Vol samplers using certified audit orifice (Completed January 9 through 10, 2006)
- Prevention of Significant Deterioration (PSD)-quality audit of 10-foot meteorological tower (Completed January 10, 2006)

All PM_{10} and TSP samplers audited on January 9 through 10, 2006, successfully passed all audit criteria. No equipment failures, leaks, or anomalies were observed during the audit procedure.

At the time of the meteorological tower audit on January 10, 2006, all sensors were operating within PSD-audit criteria. During the previous audit, a damaged precipitation gauge wire was identified. The damaged wire was observed to be replaced with a new wire and was operating correctly at the time of the audit.

Details of the quality oversight and audit summary are presented in the following sections and appendices:

- Section 2.0 PM_{10}, TSP, and Meteorological Audit Methods
- Section 3.0 Meteorological Audit Equipment
- Section 4.0 Meteorological and Air Quality Audit Summary of Results and Recommendations
- Appendix A Quality Assurance Audit Data Tables
- Appendix B Audit Equipment Standards Certifications and Field Logbook Notes

2.0 PM_{10}, TSP, and Meteorological Audit Methods

Tetra Tech personnel audited all seven PM_{10} samplers, all six TSP samplers, and the 10-foot meteorological tower on January 9-10, 2006.

The Yerington 10-foot meteorological tower sensors were audited in their normal operating modes. The accuracy of all sensors was verified using National Institute of Standards and Technology (NIST) or Certified Reference Material (CRM) traceable transfer standard reference audit sensors.

A description of audit procedures and methods is presented below.

PM_{10} Hi-Vol Audit Procedure

Seven PM_{10} Hi-Vol samplers are installed at six locations at or near the perimeter of the Yerington mine site. The samplers operate by activation of a pump via a timer system. The audit device consists of a certified audit orifice (orifice) designed for PM_{10}/TSP samplers. The orifice consists of metal plate attached to a flow restriction cylinder, which allows the user to turn a knob and restrict flow to the sampler. In addition, the orifice is equipped with a manometer port to measure pressure drop through the orifice.

The orifice is designed to produce flow ranges of 1.02 to 1.24 cubic meters per minute (m^3/min) based on the design flow rate of the PM_{10} Hi-Vol samplers. Five different flow measurements are obtained using the orifice and resultant manometer readings are recorded. PM_{10} sampler flow readings are also recorded for the five different flow rates. In addition, ambient temperature and pressure are recorded. These site-specific parameters were obtained during the audit using NIST certified devices. A slope, intercept, and correlation coefficient is calculated using the least squares regression method and is based on the five orifice manometer and sampler flow readings. The audit criteria are based on a correlation coefficient of 0.990 or higher. A summary of PM_{10} audit results is presented in Table 2-1. Quality assurance audit data tables are presented in Appendix A.

TABLE 2-1

SUMMARY OF PM_{10} AUDIT RESULTS
YERINGTON MINE SITE
JANUARY 9 -10, 2006

PM_{10} Sampler/ Location	Sampler Serial Number	Sampler Orifice Serial Number	Audit Orifice Serial Number	Ambient Temperature (degrees C^{O})	Ambient Pressure (mm Hg)	Sampler/Audit Orifice Correlation Coefficient
AM1	613	1013	W43	13.7	649.7	0.9967
AM1-DUP	616	1022	W43	12.9	649.7	0.9947
AM2	617	1016	W43	9.5	649.7	0.9966
AM3	618	1018	W43	9.1	653.0	0.9901
AM4	619	1012	W43	3.1	653.0	0.9943
AM5	614	1019	W43	7.7	653.0	0.9993
AM6	615	1020	W43	9.8	654.8	0.9930

Notes:

°C	Degree Celsius
DUP	Duplicate
mm Hg	Millimeter mercury
PM_{10}	Particulate matter less than 10 microns in diameter

TSP Hi-Vol Audit Procedure

Six TSP Hi-Vol samplers are collocated with the PM_{10} samplers and installed at six locations at or near the perimeter of the Yerington mine site. The samplers operate by the activation of a pump via a timer system, identical to the PM_{10} samplers. The audit device consists of a certified audit orifice (orifice) designed for PM_{10}/TSP samplers. The orifice consists of metal plate attached to a flow restriction cylinder, which allows the user to turn a knob and restrict flow to the sampler. In addition, the orifice is equipped with a manometer port to measure pressure drop through the orifice.

The orifice is designed to produce flow ranges of 1.10 to 1.70 cubic meters per minute (m^3/min) based on the design flow rate of the TSP Hi-Vol samplers. Five different flow measurements are obtained using the orifice and resultant manometer readings are recorded. TSP sampler flow readings are also recorded for the five different flow rates. In addition, ambient temperature and pressure are recorded. These site-specific parameters were obtained during the audit using NIST certified devices. A slope, intercept, and correlation coefficient is calculated using the least squares regression method and is based on the five orifice manometer and sampler flow readings. The audit criteria are based on a correlation coefficient of 0.990 or higher. A summary of TSP audit results is presented in Table 2-2. Quality assurance audit data tables are presented in Appendix A.

TABLE 2-2

SUMMARY OF TSP AUDIT RESULTS
YERINGTON MINE SITE
JANUARY 9 -10, 2006

TSP Sampler/ Location	Sampler Serial Number	Sampler Orifice Serial Number	Audit Orifice Serial Number	Ambient Temperature (degrees C^O)	Ambient Pressure (mm Hg)	Sampler/Audit Orifice Correlation Coefficient
AM1	NA	1033	W43	9.8	649.7	0.9992
AM2	NA	1034	W43	9.5	649.7	0.9941
AM3	NA	1014	W43	9.4	653.0	0.9995
AM4	NA	1015	W43	3.1	653.0	0.9990
AM5	NA	1017	W43	7.7	653.0	0.9962
AM6	NA	1021	W43	9.8	654.8	0.9979

Notes:

C	Degree Celsius
NA	Not available
mm Hg	Millimeter mercury
TSP	Total suspended particulate

Vane Alignment Verification/Audit

The Yerington meteorological tower wind speed/direction sensor is mounted at the top of the tower (10-foot level) on a 1-meter cross arm fixture oriented in a north/south direction, equivalent to a value of zero degrees. The vane alignment audit was achieved using a calibrated compass set on a tripod and corrected for true north offset for the Yerington, Nevada area of approximately 15.3 degrees Easterly. An additional audit was achieved using a handheld global positioning system (GPS), which automatically corrects for true north readings. Audit devices were aligned with the cross arm facing north. The orientation of the cross arm was then compared to the audit device reading. The results from the true north vane alignment audit are presented below:

- Audit compass (corrected 15.3 degrees Easterly) = 359 degrees
- Audit GPS (automatically corrected for true north) = 0.6 degrees
- Wind direction sensor aligned north-facing = 1.8 degrees

Wind Speed Audit

The wind speed audit was achieved using a R.M. Young Motor Drive (Model No. 18802) attached to the wind speed/direction sensor and was rotated at different speeds. The simulated wind speed was compared to datalogger readouts for wind speed accuracy.

In addition, a wind speed starting threshold torque audit was performed using a R.M. Young Torque Disc (Model No. 18310) to verify the sensitivity of the wind speed sensor to fluctuations in wind speed. Acceptance and accuracy criteria are presented in Table 2-3.

Wind Direction Audit

The wind direction audit was achieved using a R.M. Young Wind Direction Linearity Gauge (Model No. 18802) attached to the wind speed/direction sensor and was rotated between 0 and 360 degrees in 30-degree increments. The circular gauge has marks in 1-degree increments that were compared to the datalogger readouts for wind direction accuracy.

In addition, a wind direction starting torque audit was performed using a R.M. Young Wind Direction Torque Gauge (Model No. 18331) to verify the sensitivity of the wind direction sensor to fluctuations in wind speed. Acceptance and accuracy criteria are presented in Table 2-3.

Temperature Audit

The temperature audit was achieved using a NIST traceable reference temperature sensor collocated with the 7-foot temperature sensor. Ambient temperature readings were recorded for both sensors. The NIST traceable reference temperature sensor was compared to the 7-foot sensor for temperature accuracy. Acceptance and accuracy criteria are presented in Table 2-3.

Humidity Audit

The humidity audit was achieved using a NIST traceable reference humidity sensor (hygrometer) collocated with tower humidity sensor. Ambient humidity conditions were recorded for both sensors and dewpoint temperatures were calculated for the both sensors using ambient temperature and humidity readouts, and were compared for humidity accuracy. Acceptance and accuracy criteria are presented in Table 2-3.

Solar Radiation Audit

The solar radiation audit was achieved using a CRM traceable reference solar radiation sensor collocated with tower sensor. Four short-term solar radiation readouts were recorded for both sensors and were compared for solar radiation accuracy. Acceptance and accuracy criteria are presented in Table 2-3.

Precipitation Audit

The precipitation audit was achieved using a precise liquid dispensing tool to measure the amount of water required to initiate a tip for each tipping bucket mechanism. Three filling runs were performed for each bucket and compared to specified volume required for one tip. Acceptance and accuracy criteria are presented in Table 2-3.

Barometric Pressure Audit

The barometric pressure audit was achieved using a NIST traceable barometric pressure sensor collocated with tower sensor. Three readouts were recorded for both sensors and were compared for barometric pressure accuracy. Acceptance and accuracy criteria are presented in Table 2-3.
All quality assurance audit methods, accuracy requirements, and audit (pass/fail) results for the Yerington meteorological tower are summarized in Table 2-3. Quality assurance audit data tables are presented in Appendix A. Field logbook notes are presented in Appendix B.

Table 2-3

PSD Quality Assurance Audit Methods, Accuracy Requirements, and Results
Yerington Meteorological Tower Audit January 10, 2006

Parameter	Audit Method	Accuracy Requirements (difference between acceptable criteria and sensor response)	Within Acceptance Criteria
10-Foot Wind Speed	Active Rotation with Certified Drive Unit: ws≤5m/s ws>5m/s	≤ ± 0.25 m/s ≤ ± 5.0%	Yes
	Starting Threshold with Torque Disk	≤0.5 m/s (0.3 gm-cm)	Yes
10-Foot Wind Direction	Alignment Verification	≤ ± 5° of True North	Yes
	Internal Check of Vane Linearity using Gauge	≤ ± 3°	Yes
	Starting Threshold with Torque Gauge	≤ 0.5 m/s (9 gm-cm)	Yes
7-Foot Ambient Temperature	Collocated Sensor Comparing Temperatures Using Three Water Baths	≤ ± 0.5 °C	Yes
7-Foot Relative Humidity	Collocated Sensor Comparing Dewpoint	≤ ± 1.5 °C Error in	Yes

	Temperatures (T_{dp})	T_{dp}	
2-Meter Solar Radiation	Collocated Sensor Comparison	$\leq \pm$ 5.0% Full Scale	Yes
Barometric Pressure	Collocated Sensor Comparison	$\leq \pm$ 10 millibars Hg	Yes
Precipitation	Comparison to Precipitation Gauge	$\leq \pm$ 10.0%	Yes

Notes:

°	degree
℃	degree Celsius
gm-cm	gram-centimeter
m/s	meter per second
PSD	Prevention of significant deterioration
T_{dp}	dewpoint temperature
ws	wind speed

3.0 Meteorological Audit Equipment

All audit equipment and reference standards were in current calibration and traceable to the NIST or other authoritative references. Table 3-1 lists specific equipment used and certification dates. Copies of standard certifications for the audit equipment are presented in Appendix B.

Table 3-1

Quality Assurance Audit Equipment
Yerington PM_{10}, TSP, and Meteorological Tower Audits January 9 - 10, 2006

References/Device	Manufacturer	Model Number	Serial Number	Recertification Date
PM_{10}/TSP Audit Orifice	Tisch Environmental	TE-5028A	W43	4/06/3006
Humidity	Control Company	11-661-18	41531319	1/28/2007
Thermometer	Control Company	11-661-18	41531319	1/28/2007
Wind Speed Drive	RM Young	18802	CA02612	4/13/2006
Wind Direction Linearity Gauge	RM Young	18212	N/A	N/A
Wind Speed Starting Threshold Torque Disk	RM Young	18310	N/A	N/A
Wind Direction Starting Threshold Torque Gauge	RM Young	18331	N/A	N/A
Solar Radiation	Li-Cor	LI-200SZ	PY47392	8/13/2007
Barometric Pressure	Brunton	Multi-Navigator V 2.16	ACP 010796	4/13/2006

Notes:

N/A Not available
PM_{10} Particulate matter less than 10 microns in diameter
TSP Total suspended particulate

4.0 Meteorological and Air Quality Audit Summary of Results and Recommendations

PM_{10} and TSP Audit Summary:

At the time of the PM_{10} and TSP audit on January 9 through 10, 2006, all samplers successfully passed audit parameters and were observed to be operating correctly.

Meteorological Tower Audit:

At the time of the meteorological tower audit on January 10, 2006, all NIST and CRM reference sensors and meteorological tower sensors were compared to the accuracy requirements established in Table 2-3 and all sensors were observed to be operating within accuracy requirements.

General Recommendations:

Tetra Tech recommends that B&C continue to perform scheduled bi-weekly site visits to the meteorological tower to download data and visually inspect the sensors. In addition, downloaded data should be screened and evaluated within 48 hours to identify problems and minimize loss of data.

APPENDIX A

QUALITY ASSURANCE AUDIT DATA TABLES

TABLE 1
WIND SPEED/DIRECTION RESPONSE AUDIT

YERINGTON METEOROLOGICAL TOWER AUDIT
AUDIT DATE: January 10, 2006
SITE: Yerington Mine Site, Yerington, NV
AUDITED BY: Doug Herlocker, Tetra Tech EM Inc. on behalf of U.S. EPA

WIND SPEED: (MODEL: RM Young 05305 AQ)				WIND DIRECTION: (MODEL: RM Young 05305 AQ)		
Audit Device: RM Young Model 18802 (Serial No. CA02415)				Audit Device: RM Young Model 18212 (Serial No. N/A)		
Acceptable Difference: ws ≤ 11.0 mph = 0.56 mph, ws > 11.0 mph = ≤ 5.0%				Acceptable Difference: +/- 3 degrees		
Clockwise Rotation				Clockwise Rotation		
Calibration Device RPM	Simulated Wind Speed (mph)	ws Sensor[a] *as found* (mph)	Difference	Calibration Device (degrees)	wd Sensor *as found* (degrees)	Difference (degrees)
0.0	0.00	0.00	0.00 mph	0.0	1.8	1.8
200.0	2.19	2.28	0.09 mph	30.0	31.8	1.8
400.0	4.38	4.56	0.18 mph	60.0	61.5	1.5
600.0	6.58	6.84	0.26 mph	90.0	90.8	0.8
800.0	8.77	9.12	0.35 mph	120.0	120.3	0.3
1000.0	10.96	11.40	0.44 mph	150.0	150.2	0.2
1600.0	17.54	18.24	4.0 %	180.0	179.7	-0.3
2200.0	24.11	25.08	4.0 %	210.0	210.0	0.0
2600.0	28.50	29.64	4.0 %	240.0	239.9	-0.1
3000.0	32.88	34.20	4.0 %	270.0	271.6	1.6
Criteria met (yes/no): YES				300.0	301.2	1.2
Adjustment performed (yes/no): YES				330.0	330.9	0.9
				360/0.0	2.40	2.4
				Criteria met (yes/no): YES		
				Adjustment performed (yes/no): YES		

Notes:

[a]	RM Young wind speed multiplier used with calibration device: (RPM x 0.01096)=mph, (RPM x 0.005)=m/s
[b]	Wind Speed less than or equal to 11 miles per hour is compared to actual simulated wind speed miles per hour.
[c]	Wind Speed greater than 11 miles per hour is compared to percent difference of simulated wind speed miles per hour.
%	Percent
EPA	U.S. Environmental Protection Agency
mph	Mile per hour
m/s	meter per second
N/A	Not available
RPM	Revolutions per minute
wd	Wind direction
ws	Wind speed

TABLE 2
WIND DIRECTION/SPEED STARTING THRESHOLD TORQUE AUDIT

YERINGTON METEOROLOGICAL TOWER AUDIT
AUDIT DATE: January 10, 2006
SITE: Yerington Mine Site, Yerington, NV
AUDITED BY: Doug Herlocker, Tetra Tech EM Inc. on behalf of U.S. EPA

WIND SPEED STARTING TORQUE THRESHOLD: (MODEL: RM Young 05305 AQ)		WIND DIRECTION STARTING TORQUE THRESHOLD: (MODEL: RM Young 05305 AQ)	
Audit Device: RM Young Model 18310 (Serial No. N/A)		Audit Device: RM Young Model 18331 (Serial No. N/A)	
Acceptable Difference: ≤ 0.3 g-cm		Acceptable Difference: ≤ 9 g-cm	
Sensor	ws Sensor *as found* (g-cm)	Sensor	wd Sensor *as found* (g-cm)
10 meter ws	0.1	10 meter wd	N/A
Sensor	ws Sensor *as left* (g-cm)	Sensor	wd Sensor *as left* (g-cm)
10 meter ws	0.1	10 meter wd	N/A
Criteria met (yes/no): NO		Criteria met (yes/no): NO	
Adjustment performed (yes/no): NO		Adjustment performed (yes/no): NO	

Notes:

EPA	U.S. Environmental Protection Agency
g-cm	Gram-centimeter
N/A	Not available
ws	Wind speed
wd	Wind direction

TABLE 3
HUMIDITY AUDIT

YERINGTON METEOROLOGICAL TOWER AUDIT
AUDIT DATE: January 10, 2006
SITE: Yerington Mine Site, Yerington, NV
AUDITED BY: Doug Herlocker, Tetra Tech EM Inc. on behalf of U.S. EPA

HUMIDITY: Vaisala Model HMP45C with Campbell CR10X Datalogger

Audit Device[a]: Control Company Model No. 11-661-18 (Serial No. 41531319)

Acceptable Difference: +/- 4.1 °F in Dewpoint Temperature

Audit device (% humidity)	Humidity Sensor *as found* (% humidity)	Difference (% humidity)	Audit device Dewpoint Temperature (°F)	Humidity Sensor Dewpoint Temperature (°F)	Dewpoint Difference Temperature (°F)
40.1	40.4	0.3	35.40	35.10	-0.30
Criteria met (yes/no): YES			Adjustment performed (yes/no): NO		

Notes:

[a]	Audit device meets National Institute of Standards and Technology requirements.
%	Percent
°F	Fahrenheit
EPA	U.S. Environmental Protection Agency

TABLE 4
AMBIENT TEMPERATURE AUDIT

YERINGTON METEOROLOGICAL TOWER AUDIT
AUDIT DATE: January 10, 2006
SITE: Yerington Mine Site, Yerington, NV
AUDITED BY: Doug Herlocker, Tetra Tech EM Inc. on behalf of U.S. EPA

TEMPERATURE: Vaisala Model HMP45C with Campbell CR10X Datalogger

Audit Device[a]: Control Company Model No. 11-661-18 (Serial No. 41531319)

Acceptable Difference: +/- 1.0 °F Mean Error

Temperature Range	Audit Device Temperature (°F)	Ambient Temperature *as found* (°F)	Difference (°F)
Ambient range	53.1	52.6	-0.5
		Mean Error =	-0.5
Criteria met (yes/no): YES		Adjustment performed (yes/no): NO	

Notes:

[a]	Audit device meets National Institute of Standards and Technology requirements.
°F	Fahrenheit
EPA	U.S. Environmental Protection Agency

TABLE 5
SOLAR RADIATION AUDIT

YERINGTON METEOROLOGICAL TOWER AUDIT
AUDIT DATE: January 10, 2006
SITE: Yerington Mine Site, Yerington, NV
AUDITED BY: Doug Herlocker, Tetra Tech EM Inc. on behalf of U.S. EPA

SOLAR RADIATION: Kipp & Zonen with Campbell CR10X Datalogger

Audit Device[a]: Licor Model LI200SZ (serial #PY47392)

Acceptable Difference: < 5% (Full Scale)

Audit Device Zero[b] (W/m^2)	Sensor Device Zero[b] (W/m^2)	Audit Device 1st. Reading (W/m^2)	Sensor Device 1st. Reading (W/m^2)	Audit Device 2nd. Reading (W/m^2)	Sensor Device 2nd. Reading (W/m^2)	
0.0	0.0	419.0	434.0	418.0	432.0	
Criteria met (yes/no): YES		Adjustment performed (yes/no): NO				

Notes:

[a]	Audit device meets National Institute of Standards and Technology requirements.
[b]	Audit and sensor devices covered to simulate night time environment.
EPA	U.S. Environmental Protection Agency
W/m^2	Watts per meter squared
N/A	Not available

TABLE 6
PRECIPITATION AUDIT

YERINGTON METEOROLOGICAL TOWER AUDIT

AUDIT DATE: January 10, 2006

SITE: Yerington Mine Site, Yerington, NV

AUDITED BY: Doug Herlocker, Tetra Tech EM Inc. on behalf of U.S. EPA

PRECIPITATION: Climatronics Model 100508 (Serial No. 935) with Campbell CR510 Datalogger (Serial No. 18)

Audit device: 10 mL syringe (Serial No. N/A)

Acceptable Difference: +/- 10% (1 tip = 8.3 mL = 0.01 inches of precipitation), <8.0 mL, > 8.6 mL = adjustment recommended

Volume Checks (number)	Left Bucket *as found*	Right Bucket *as found*
1	8.6	8.0
2	8.4	8.0
3	8.3	8.1
Average =	**8.4**	**8.0**
Volume Checks (number)	**Left Bucket *as left***	**Right Bucket *as left***
1	8.6	8.0
2	8.4	8.0
3	8.3	8.1
Average =	**8.4**	**8.0**
	Citeria met (yes/no): YES	**Citeria met (yes/no): YES**
	Adjustment performed (yes/no): NO	**Adjustment performed (yes/no): NO**

Notes:

%	**Percent**
EPA	**U.S. Environmental Protection Agency**
mL	**Milliliter**
N/A	**Not available**

APPENDIX B

AUDIT EQUIPMENT STANDARDS CERTIFICATIONS AND FIELD LOGBOOK NOTES

TISCH ENVIROMENTAL, INC.
145 SOUTH MIAMI AVE.
VILLAGE OF CLEVES, OH 45002
513.467.9000
877.263.7610 TOLL FREE
513.467.9009 FAX
WWW.TISCH-ENV.COM

AIR POLLUTION MONITORING EQUIPMENT

ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET TE-5028A

Date - Apr 06, 2005 Rootsmeter S/N 9833620 Ta (K) - 295
Operator Tisch Orifice I.D. - W43 Pa (mm) - 753.11

PLATE OR VDC #	VOLUME START (m3)	VOLUME STOP (m3)	DIFF VOLUME (m3)	DIFF TIME (min)	METER DIFF Hg (mm)	ORFICE DIFF H2O (in.)
1	NA	NA	1.00	1.2560	4.5	1.50
2	NA	NA	1.00	0.9750	7.4	2.50
3	NA	NA	1.00	0.8880	8.9	3.00
4	NA	NA	1.00	0.8200	10.3	3.50
5	NA	NA	1.00	0.6190	17.7	6.00

DATA TABULATION

Vstd	(x axis) Qstd	(y axis)
0.9950	0.7922	1.2254
0.9912	1.0166	1.5819
0.9892	1.1139	1.7329
0.9873	1.2040	1.8718
0.9774	1.5790	2.4507

Qstd slope (m) = 1.55515
intercept (b) = -0.00218
coefficient (r) = 0.99994

y axis = SQRT[H2O(Pa/760)(298/Ta)]

Va	(x axis) Qa	(y axis)
0.9940	0.7914	0.7665
0.9902	1.0155	0.9896
0.9882	1.1128	1.0840
0.9863	1.2028	1.1709
0.9764	1.5774	1.5331

Qa slope (m) = 0.97381
intercept (b) = -0.00137
coefficient (r) = 0.99994

y axis = SQRT[H2O(Ta/Pa)]

CALCULATIONS

Vstd = Diff. Vol[(Pa-Diff. Hg)/760](298/Ta)
Qstd = Vstd/Time

Va = Diff Vol [(Pa-Diff Hg)/Pa]
Qa = Va/Time

For subsequent flow rate calculations:

Qstd = 1/m{[SQRT(H2O(Pa/760)(298/Ta))}- b}
Qa = 1/m{[SQRT H2O(Ta/Pa)]- b}

ACCREDITED

Calibration complies with ISO 17025

Cert. No.:4185-1049515

Traceable® Certificate of Calibration for Digital Hygrometer/Thermometer

Instrument Identification:

Model: 11-661-18 S/N: 41531319 Manufacturer : Control Company

Standards/Equipment:

Description	Serial Number	Due Date	NIST Traceable Reference
Digital Thermometer	41334977/41335007	9/24/05	4000:542181
Chilled Mirror Hygrometer	414	10/22/05	4136 (200562-0)

Certificate Information:

Technician: 61 Procedure: CAL-17 Cal Date: 1/28/05 **Cal Due: 1/28/07**

Test Conditions: 24.0°C 39.0 %RH 1016 mBar

Calibration Data: (New Instrument)

Unit(s)	Nominal	As Found	In Tol	Nominal	As Left	In Tol	Min	Max	±uc	TUR
°C		N.A.		27.49	27.3	Y	26.5	28.5	0.09	>4:1
%RH		N.A.		20.63	24.5	Y	16.6	24.6	0.88	>4:1
%RH		N.A.		39.10	40.0	Y	37.1	41.1	0.88	2.3:1
%RH		N.A.		72.86	73.8	Y	68.9	76.9	0.88	>4:1

This Instrument was calibrated using Instruments Traceable to National Institute of Standards and Technology.

A Test Uncertainty Ratio of at least 4:1 is maintained unless otherwise stated and is calculated using the expanded measurement uncertainty. Uncertainty evaluation includes the instrument under test and is calculated in accordance with the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM). The uncertainty represents an expanded uncertainty using a coverage factor k=2 to approximate a 95% confidence level. In tolerance conditions are based on test results falling within specified limits with no reduction by the uncertainty of the measurement. The results contained herein relate only to the item calibrated. This certificate shall not be reproduced except in full.

Wallace Berry

Wallace Berry, Technical Manager

Maintaining Accuracy:

In our opinion once calibrating your Digital Hygrometer/Thermometer should maintain its accuracy. There is no exact way to determine how long calibration will be maintained. Digital Hygrometer/Thermometers change little, if any at all, but can be affected by aging, temperature, shock, and contamination.

Recalibration:

For factory calibration and re-certification traceable to National Institute of Standards and Technology contact Control Company.

CONTROL COMPANY 4455 Rex Road Friendswood, TX 77546 USA
Phone 281 482-1714 Fax 281 482-9448 service@control3.com www.control3.com

R.M. Young Company
2801 Aero Park Drive
Traverse City, Michigan 49686 USA

Certificate of Calibration and Testing

Test Unit:			
Model:	18802	Serial Number:	CA02612
Description:	Anemometer Drive - 200 to 15,000 Rpm - Comprised of Models 18820A Control Unit & 18830A Motor Assembly		

R.M. Young Company certifies that the above equipment has been inspected and calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technologies (NIST).

Nominal Motor Rpm	27106D Output Frequency Hz (1)	Calculated Rpm (2)	Indicated Rpm (3)
300	50	300	300
2700	450	2700	2700
5100	850	5100	5100
7500	1250	7500	7500
10,200	1700	10200	10200
12,600	2100	12600	12600
15,000	2500	15000	15000
☒ Clockwise and Counterclockwise rotation verified			

(1) Measured frequency output of RM Young Model 27106D standard anemometer attached to motor shaft
(2) 27106D produces 10 pulses per revolution of the anemometer shaft
(3) Indicated on the Control Unit LCD display

*Indicates out of tolerance

☒ No Calibration Adjustments Required ☐ As Found ☐ As Left

Traceable frequency meter used in calibration DP4863

Date of inspection 13 April 2005

Tested By EJC

Tel: 231-946-3980 Fax: 231-946-4772 Email: met.sales@youngusa.com Website: www.youngusa.com

Certificate of Accuracy

Transfer Standard Type: Barometric Pressure/Altimeter

Transfer standard model: Brunton Multi-Navigator, Version 2.16
Serial number: ACP 010796
submitted by/owner: Tetra Tech EMI, Boise Idaho

Was compared to Precision Absolute Reference Barometer:
Model number: 355-AI0900 Serial number: 913930-M1
Certified accuracy of ± 0.007"Hg
NIST traceable to Ruska Deadweight Tester SN 38342/C-85

Date: 4/13/2005

Lab temperature	73.5	°F
Lab pressure	657.6	mm Hg

Reference barometer (in. Hg)	Transfer Standard (in. Hg)	Difference from Reference (in. Hg)	Transfer Standard Correction* (in. Hg)
25.89	25.87	-0.02	0.02
26.50	26.49	-0.01	0.01
26.75	26.74	-0.01	0.01
27.00	26.99	-0.01	0.01

Note:
If no sign is given on the correction, the true pressure is higher than the indicated pressure. If the sign is negative, the true pressure is lower than the indicated pressure.

Transfer Standard adjustments made? YES ☐ NO ☒
Post-calibration measurements:

Reference barometer (in. Hg)	Transfer Standard (in. Hg)	Difference from Reference (in. Hg)	Transfer Standard Correction* (in. Hg)

Reviewed: RJF Date: 4-13-05

Chinook Engineering
a division of Inter-Mountain Laboratories, Inc.
556 Absaraka Street
Sheridan, Wyoming 82801 USA
(307) 672-7790
chinook@imlinc.com

1-10-06
1150 Arrive at Met Tower
1200 Check True North Vane orientation
1205 Met Tower Off line

GPS Check = 359-1°
Sighting Compass: 345° uncorrected, 0.6° Corrected
Corrected Compass = 0.0°

Barometric Pressure:
Audit = 25.61" Hg = 650.49 mm Hg
Sensor = 869.2 mb = 652.0 mm Hg

Precipitation:
Lft Bucket → Tip 1 = 8.6 (8.3% - 10%)
Tip 2 = 8.4
Tip 3 = 8.3
Rt. Bucket → Tip 1 = 8.0
Tip 2 = 8.0
Tip 3 = 8.1

Wind Speed/Direction:
1. Wind speed Linearity = Passed (Data on Excel sheet)
2. Wind direction " = " " " " "
3. wind speed starting torque = (Ave) 7 g/cm
4. wind direction starting torque = N/A

1-10-06 (Continued)
Temp: Audit = 53.1
Sensor: 52.6

Humidity: Audit = 40.1%
Sensor = 40.4%

Solar Radiation
Sensor As Found
Zero (Capped) = 0.00 w/m²
Reading #1 = 0.434 / 0.865
" #2 = 0.432 / 0.864
#3 = 0.431 / 0.862
Audit Sensor As Found
Zero Capped = 0.00 w/m²
Reading #1 = 0.419
" #2 = 0.418
#3 = 0.418

1355 Audit Completed → All parameters Passed
1356 Met Tower Online
1415 Leave site

Observations:
1. All Sensors functioning Properly
2. Wind Sensor tail showing wear. Replacement Recommended
3. w/ Assistance from B&C, Slight adjustment made to Precip. Bevel set Screw

Project: Yerington/ARC AQ AM1 PM10 Site

Monitor: Tisch Environmental PM10 Hi-Vol Sampler Model # TE-6070D

Sampler Serial #	613	Ta	Temp C	13.7	Orifice Serial #	w43
Orifice Serial #	1013	Ta	Temp K	286.85	W43 slope (m)	0.97381
		Pa	Bp mm Hg	649.732	W43 int. (b)	-0.00137
Date: January 9-10, 2006		Pa	Bp in Hg	25.58		

Point	Orifice Press. Drop (" H2O)	Qa (Orifice) (1.02-1.24)	Chart Response	IC Corrected	Linear Regression	
1	3.2	1.2220	37	24.6	Slope=	21.07347812
2	3.0	1.1832	36	23.9	Intercept=	-1.1154
3	2.7	1.1226	34	22.6	**Corr. Coeff.=**	**0.9967**
4	2.6	1.1016	33	21.9	SFR=	1.2196
5	2.4	1.0584	32	21.3	SSP=	37.0029

Project: Yerington/ARC AQ AM1 PM10 DUP Site

Monitor: Tisch Environmental PM10 Hi-Vol Sampler Model # TE-6070D

Sampler Serial #	616	Ta	Temp C	12.9	Orifice Serial #	w43
Orifice Serial #	1022	Ta	Temp K	286.05	W43 slope (m)	0.97381
		Pa	Bp mm Hg	649.732	W43 int. (b)	-0.00137
Date: January 9-10, 2006		Pa	Bp in Hg	25.58		

Point	Orifice Press. Drop (" H2O)	Qa (Orifice) (1.02-1.24)	Chart Response	IC Corrected	Linear Regression	
1	2.2	1.0134	31	20.6	Slope=	26.83514709
2	2.4	1.0584	32	21.3	Intercept=	-6.8445
3	2.6	1.1016	34	22.6	**Corr. Coeff.=**	**0.9947**
4	2.9	1.1634	37	24.6	SFR=	8.0000
5	3.2	1.2220	39	25.9	SSP=	313.2336

Project: Yerington/ARC AQ AM1 TSP site

Monitor: Tisch Environmental TSP Hi-Vol Sampler Model # TE-5170D

Sampler Serial #		Ta	Temp C	9.8	Orifice Serial #	w43
Orifice Serial #	1033	Ta	Temp K	282.95	W43 slope (m)	0.97381
		Pa	BP mm Hg	649.732	W43 int. (b)	-0.00137
Date: January 9-10, 2006		Pa	Bp in Hg	25.58		

Point	Orifice Press. Drop (" H2O)	Qa (Orifice) (1.10-1.70)	Chart Response	IC Corrected	Linear Regression	
1	4	1.3660	39	25.9	Slope=	18.59464845
2	4.2	1.3997	40	26.6	Intercept=	0.5018
3	4.7	1.4806	42	27.9	**Corr. Coeff.=**	**0.9992**
4	5.1	1.5423	44	29.2	SFR=	1.2031
5	5.6	1.6161	46	30.6	SSP=	34.6592

Project: Yerington/ARC AQ AM2 PM10 site

Monitor: Tisch Environmental PM10 Hi-Vol Sampler Model # TE-6070D

Sampler Serial #	617	Ta	Temp C	9.5	Orifice Serial #	w43
Orifice Serial #	1016	Ta	Temp K	282.65	W43 slope (m)	0.97381
		Pa	Bp mm Hg	649.732	W43 int. (b)	-0.00137
Date: January 9-10, 2006		Pa	Bp in Hg	25.58		

Point	Orifice Press. Drop (" H2O)	Qa (Orifice) (1.02-1.24)	Chart Response	IC Corrected	Linear Regression	
1	3.1	1.1939	36	23.7	Slope=	23.14822554
2	3.0	1.1745	35	23.1	Intercept=	-4.0203
3	2.6	1.0935	32	21.1	**Corr. Coeff.=**	**0.9966**
4	2.4	1.0507	31	20.4	SFR=	1.2018
5	2.3	1.0286	30	19.8	SSP=	36.0824

Project: Yerington/ARC AQ AM2 TSP site

Monitor: Tisch Environmental TSP Hi-Vol Sampler Model # TE-5170D

Sampler Serial #	NA	Ta	Temp C	9.5	Orifice Serial #	w43
Orifice Serial #	1034	Ta	Temp K	282.65	W43 slope (m)	0.97381
		Pa	BP mm Hg	649.732	W43 int. (b)	-0.00137
Date: January 9-10, 2006		Pa	Bp in Hg	25.58		

Point	Orifice Press. Drop (" H2O)	Qa (Orifice) (1.10-1.70)	Chart Response	IC Corrected	Linear Regression	
1	3.7	1.3042	38	25.1	Slope=	23.25564999
2	4.3	1.4059	41	27.0	Intercept=	-5.3475
3	4.9	1.5007	45	29.7	**Corr. Coeff.=**	**0.9941**
4	5.2	1.5459	47	31.0	SFR=	1.2018
5	5.6	1.6042	48	31.7	SSP=	34.2658

Project: Yerington/ARC AQ AM3 PM10 site

Monitor: Tisch Environmental PM10 Hi-Vol Sampler Model # TE-6070D

Sampler Serial #	618	Ta	Temp C	9.1	Orifice Serial #	w43
Orifice Serial #	1018	Ta	Temp K	282.25	W43 slope (m)	0.97381
		Pa	Bp mm Hg	653.034	W43 int. (b)	-0.00137
Date: January 9-10, 2006		Pa	Bp in Hg	25.71		

Point	Orifice Press. Drop (" H2O)	Qa (Orifice) (1.02-1.24)	Chart Response	IC Corrected	Linear Regression	
1	3.3	1.2185	39	25.6	Slope=	20.0859134
2	3.0	1.1707	37	24.3	Intercept=	1.0636
3	2.7	1.1107	36	23.7	**Corr. Coeff.=**	**0.9901**
4	2.5	1.0689	34	22.4	SFR=	1.1940
5	2.3	1.0253	33	21.7	SSP=	38.0974

Project: Yerington/ARC AQ AM3 TSP site

Monitor: Tisch Environmental TSP Hi-Vol Sampler Model # TE-5170D

Sampler Serial #	NA	Ta	Temp C	9.4	Orifice Serial #	w43
Orifice Serial #	1014	Ta	Temp K	282.55	W43 slope (m)	0.97381
		Pa	BP mm Hg	653.034	W43 int. (b)	-0.00137
Date: January 9-10, 2006		Pa	Bp in Hg	25.71		

Point	Orifice Press. Drop (" H2O)	Qa (Orifice) (1.10-1.70)	Chart Response	IC Corrected	Linear Regression	
1	2.8	1.1311	35	23.0	Slope=	19.72410619
2	3.1	1.1901	37	24.3	Intercept=	0.7259
3	3.7	1.3000	40	26.3	**Corr. Coeff.=**	**0.9995**
4	4.1	1.3684	42	27.6	SFR=	1.1953
5	5.1	1.5260	47	30.9	SSP=	36.9450

Project: Yerington/ARC AQ AM4 PM10 site

Monitor: Tisch Environmental PM10 Hi-Vol Sampler Model # TE-6070D

Sampler Serial #	619	Ta	Temp C	3.1	Orifice Serial #	w43
Orifice Serial #	1012	Ta	Temp K	276.25	W43 slope (m)	0.97381
		Pa	Bp mm Hg	653.034	W43 int. (b)	-0.00137
Date: January 9-10, 2006		Pa	Bp in Hg	25.71		

Point	Orifice Press. Drop (" H2O)	Qa (Orifice) (1.02-1.24)	Chart Response	IC Corrected	Linear Regression	
1	3.3	1.2147	39	25.4	Slope=	23.08031607
2	3.1	1.1774	37	24.1	Intercept=	-2.8935
3	2.8	1.1190	35	22.8	**Corr. Coeff.=**	**0.9943**
4	2.6	1.0784	34	22.1	SFR=	1.1686
5	2.4	1.0253	32	20.8	SSP=	37.0211

Project: Yerington/ARC AQ AM4 TSP site

Monitor: Tisch Environmental TSP Hi-Vol Sampler Model # TE-5170D

Sampler Serial #	NA	Ta	Temp C	3.1	Orifice Serial #	w43
Orifice Serial #	1015	Ta	Temp K	276.25	W43 slope (m)	0.97381
		Pa	BP mm Hg	653.034	W43 int. (b)	-0.00137
Date: January 9-10, 2006		Pa	Bp in Hg	25.71		

Point	Orifice Press. Drop (" H2O)	Qa (Orifice) (1.10-1.70)	Chart Response	IC Corrected	Linear Regression	
1	2.9	1.1388	35	22.8	Slope=	21.46164197
2	3.5	1.2509	39	25.4	Intercept=	-1.6413
3	4.1	1.3538	42	27.3	**Corr. Coeff.=**	**0.9990**
4	4.9	1.4799	46	29.9	SFR=	1.1686
5	5.4	1.5535	49	31.9	SSP=	36.0380

Project: Yerington/ARC AQ AM5 PM10 site

Monitor: Tisch Environmental PM10 Hi-Vol Sampler Model # TE-6070D

Sampler Serial #	614	Ta	Temp C	7.7	Orifice Serial #	w43
Orifice Serial #	1019	Ta	Temp K	280.85	W43 slope (m)	0.97381
		Pa	Bp mm Hg	653.034	W43 int. (b)	-0.00137
Date: January 9-10, 2006		Pa	Bp in Hg	25.71		

Point	Orifice Press. Drop (" H2O)	Qa (Orifice) (1.02-1.24)	Chart Response	IC Corrected	Linear Regression	
1	2.3	1.0227	32	21.0	Slope=	20.20337557
2	2.6	1.0873	34	22.3	Intercept=	0.3414
3	2.8	1.1182	35	23.0	**Corr. Coeff.=**	**0.9993**
4	2.9	1.1482	36	23.6	SFR=	1.3279
5	3.1	1.1871	37	24.3	SSP=	41.4284

Project: Yerington/ARC AQ AM5 TSP site

Monitor: Tisch Environmental TSP Hi-Vol Sampler Model # TE-5170D

Sampler Serial #	NA	Ta	Temp C	7.7	Orifice Serial #	w43
Orifice Serial #	1017	Ta	Temp K	280.85	W43 slope (m)	0.97381
		Pa	BP mm Hg	653.034	W43 int. (b)	-0.00137
Date: January 9-10, 2006		Pa	Bp in Hg	25.71		

Point	Orifice Press. Drop (" H2O)	Qa (Orifice) (1.10-1.70)	Chart Response	IC Corrected	Linear Regression	
1	3.1	1.1871	38	24.9	Slope=	19.50137328
2	3.5	1.2613	41	26.9	Intercept=	2.0185
3	3.9	1.3313	42.5	27.9	**Corr. Coeff.=**	**0.9962**
4	4.3	1.3979	45	29.5	SFR=	1.1881
5	5.3	1.5518	49	32.1	SSP=	38.4078

Project: Yerington/ARC AQ AM6 PM10 site

Monitor: Tisch Environmental PM10 Hi-Vol Sampler Model # TE-6070D

Sampler Serial #	615	**Ta**	**Temp C**	**9.8**	**Orifice Serial #**	**w43**
Orifice Serial #	1020	**Ta**	**Temp K**	**282.95**	**W43 slope (m)**	**0.97381**
		Pa	**Bp mm Hg**	**654.812**	**W43 int. (b)**	**-0.00137**
Date: January 9-10, 2006		**Pa**	**Bp in Hg**	**25.78**		

Point	Orifice Press. Drop (" H2O)	Qa (Orifice) (1.02-1.24)	Chart Response	IC Corrected	Linear Regression	
1	2.4	1.0472	34	22.3	Slope=	23.19629628
2	2.6	1.0899	35	23.0	Intercept=	-2.0529
3	2.8	1.1309	37	24.3	**Corr. Coeff.=**	**0.9930**
4	3.0	1.1706	38	25.0	SFR=	1.1937
5	3.1	1.1899	39	25.6	SSP=	39.0004

Project: Yerington/ARC AQ AM6 TSP site

Monitor: Tisch Environmental TSP Hi-Vol Sampler Model # TE-5170D

Sampler Serial #	NA	**Ta**	**Temp C**	**9.8**	**Orifice Serial #**	**w43**
Orifice Serial #	1021	**Ta**	**Temp K**	**282.95**	**W43 slope (m)**	**0.97381**
		Pa	**BP mm Hg**	**654.812**	**W43 int. (b)**	**-0.00137**
Date: January 9-10, 2006		**Pa**	**Bp in Hg**	**25.78**		

Point	Orifice Press. Drop (" H2O)	Qa (Orifice) (1.10-1.70)	Chart Response	IC Corrected	Linear Regression	
1	3.5	1.2643	38	25.0	Slope=	19.89048839
2	3.9	1.3345	40	26.3	Intercept=	-0.1468
3	4.2	1.3848	42	27.6	**Corr. Coeff.=**	**0.9979**
4	4.7	1.4648	44	28.9	SFR=	1.1937
5	4.9	1.4956	45	29.6	SSP=	35.8968