Buckskin Mine
Ambient Air Monitoring Network

3rd Quarter 2006

Prepared by:

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REPORT SUMMARY

Network Operation

This particulate and meteorological monitoring network is operated in accordance with Buckskin Mine Quality Assurance Project Plan (QAPP) submitted in March 2001. Ambient particulate data are collected at two sites (North Site and West Site). The network consists of two low volume R&P TEOM PM_{10} continuous particulate monitors (N-TEOM and W-TEOM). The meteorological station is located at the North Site.

Routine service and quality assurance audits were performed on both the N-TEOM and W-TEOM PM_{10} monitors this quarter. Quality assurance audit details are located in Appendix C.

Results

No 24-hour PM_{10} concentrations exceeded 150 µg/m^3 this quarter. Refer to Appendix A for more particulate sample information.

Year-to-date statistics (01/01/06 – 09/30/06), for the samplers are as follows:

2006 annual statistics at STP

Parameter	Concentration (µg/m^3)	
	N-TEOM	W-TEOM
Mean YTD	23.5	20.2
High 24-hour	101.4	63.7
2nd High 24-hour	84.7	58.6

2006 annual statistics at LTP

Parameter	Concentration (µg/m^3)	
	N-TEOM	W-TEOM
Mean YTD	20.8	18.1
99th Percentile 24-hour	61.6	52.1

Meteorological monitoring results are presented in Appendix B.

Data Recovery

The North and West TEOM monitors had data recoveries of 93.5% and 64.1%, respectively. The North TEOM has six invalid days during the quarter. One day was due to missing data, while the additional days were invalid due to the sample flow being out of limits. The West TEOM CPU board failed on August 7 invalidating 33 days of data. The board was replaced on September 7 and an audit was performed. Refer to Appendix E for a detailed explanation of the lost data from both Buckskin and IML.

Particulate Monitor Data Recovery (%)

Period	N-TEOM	W-TEOM
3rd Quarter	93.5	64.1
2006 (YTD)	97.8	87.9

The quarterly meteorological data recovery was 99.91% for all parameters except temperature which has a recovery of 99.73%. The temperature sensor malfunctioned four hours during the quarter invalidating data. An additional two hours of data for all parameters was invalidated during the station audit on August 1, 2006.

Meteorological Data Recovery (%)

Period	Wind Speed	Wind Direction	σ_θ	Temp	Precipitation
3rd Quarter	99.91	99.91	99.91	99.73	99.91
2006 (YTD)	92.09	92.09	92.09	91.87	92.09

Appendix A

Particulate Data

Daily TEOM PM_{10} concentrations
Precision data for TEOM samplers

Buckskin Mine - North

3rd Quarter 2006

Daily Average TEOM Concentrations (microgram/cubic meter)

July			August			September		
	STP	LTP		STP	LTP		STP	LTP
7/1/2006	16.9	14.7	8/1/2006	48.4	41.5	9/1/2006	17.3	16.0
7/2/2006	25.7	22.5	8/2/2006	23.9	20.7	9/2/2006	17.0	15.6
7/3/2006	24.7	21.4	8/3/2006	46.9	40.1	9/3/2006	30.8	27.8
7/4/2006	27.3	23.6	8/4/2006	62.1	53.2	9/4/2006	22.2	19.7
7/5/2006	41.6	35.4	8/5/2006	36.8	31.9	9/5/2006	47.4	41.9
7/6/2006	45.6	38.8	8/6/2006	53.0	45.0	9/6/2006	36.9	32.8
7/7/2006	17.9	15.6	8/7/2006	33.7	28.5	9/7/2006	52.8	46.9
7/8/2006	24.6	21.2	8/8/2006	19.2	16.3	9/8/2006	40.8	35.9
7/9/2006	15.6	13.5	8/9/2006	25.7	21.7	9/9/2006	30.4	26.9
7/10/2006	34.7	29.2	8/10/2006	38.8	33.8	9/10/2006	30.8	27.2
7/11/2006	36.9	30.6	8/11/2006	30.8	26.3	9/11/2006	32.6	29.4
7/12/2006	30.6	26.5	8/12/2006	21.8	19.4	9/12/2006	35.5	31.4
7/13/2006			8/13/2006	10.3	9.2	9/13/2006	70.8	61.6
7/14/2006	46.8	39.5	8/14/2006	40.0	34.6	9/14/2006	63.1	54.3
7/15/2006	56.4	47.0	8/15/2006	29.9	25.6	9/15/2006	21.5	19.0
7/16/2006	62.6	52.4	8/16/2006	68.9	60.5	9/16/2006	1.1	1.0
7/17/2006	84.7	70.6	8/17/2006	35.6	31.8	9/17/2006	2.2	2.0
7/18/2006	101.4	83.6	8/18/2006	14.8	13.1	9/18/2006	7.4	6.8
7/19/2006	65.1	54.8	8/19/2006	33.5	28.9	9/19/2006	19.1	17.1
7/20/2006			8/20/2006	55.9	49.1	9/20/2006	19.2	17.2
7/21/2006	20.0	17.6	8/21/2006	46.4	40.1	9/21/2006	7.3	6.5
7/22/2006	56.5	47.9	8/22/2006	46.4	40.0	9/22/2006	4.2	3.8
7/23/2006			8/23/2006	43.1	36.3	9/23/2006	5.6	5.2
7/24/2006	33.4	27.6	8/24/2006	63.6	56.0	9/24/2006	5.6	5.1
7/25/2006	22.2	18.8	8/25/2006	50.6	45.1	9/25/2006	6.2	5.5
7/26/2006			8/26/2006	26.7	23.6	9/26/2006	8.8	7.9
7/27/2006			8/27/2006	18.7	16.8	9/27/2006	6.1	5.6
7/28/2006			8/28/2006	20.7	18.2	9/28/2006	14.3	12.8
7/29/2006	63.3	51.8	8/29/2006	49.4	42.3	9/29/2006	17.9	16.0
7/30/2006	39.1	32.6	8/30/2006	38.4	32.7	9/30/2006	25.1	22.3
7/31/2006	48.2	40.8	8/31/2006	62.9	56.3			

TEOM Summary Statistics

July		
	STP	LTP
Mean	41.7	35.1
High	101.4	83.6
2nd High	84.7	70.6
Recovery	80.6%	

August		
	STP	LTP
Mean	38.6	33.5
High	68.9	60.5
2nd High	63.6	56.3
Recovery	100.0%	

September		
	STP	LTP
Mean	23.3	20.7
High	70.8	61.6
2nd High	63.1	54.3
Recovery	100.0%	

3rd Quarter 2006

	STP	LTP
Mean	34.2	29.5
High	101.4	83.6
2nd High	84.7	70.6
Recovery	93.5%	

Buckskin Mine - West

3rd Quarter 2006

Daily Average TEOM Concentrations (microgram/cubic meter)

	July			August			September	
	STP	LTP		STP	LTP		STP	LTP
7/1/2006	17.7	15.9	8/1/2006	47.6	41.6	9/1/2006		
7/2/2006	20.6	18.5	8/2/2006	25.5	22.3	9/2/2006		
7/3/2006	22.8	20.4	8/3/2006	34.4	29.7	9/3/2006		
7/4/2006	22.2	19.8	8/4/2006	37.4	32.3	9/4/2006		
7/5/2006	29.3	25.5	8/5/2006	30.6	26.9	9/5/2006		
7/6/2006	31.4	27.3	8/6/2006	39.4	34.0	9/6/2006		
7/7/2006	20.3	17.9	8/7/2006			9/7/2006		
7/8/2006	16.0	14.1	8/8/2006			9/8/2006		
7/9/2006	15.5	13.8	8/9/2006			9/9/2006	23.4	20.6
7/10/2006	30.2	25.9	8/10/2006			9/10/2006	20.2	18.0
7/11/2006	38.2	32.5	8/11/2006			9/11/2006	31.8	28.7
7/12/2006	54.1	47.5	8/12/2006			9/12/2006	33.1	29.4
7/13/2006	18.5	16.0	8/13/2006			9/13/2006	56.8	49.4
7/14/2006	38.8	33.4	8/14/2006			9/14/2006	43.9	37.9
7/15/2006	39.4	33.7	8/15/2006			9/15/2006	20.2	18.0
7/16/2006	51.6	45.2	8/16/2006			9/16/2006	3.9	3.6
7/17/2006	56.8	48.8	8/17/2006			9/17/2006	3.6	3.3
7/18/2006	63.7	54.3	8/18/2006			9/18/2006	6.6	6.1
7/19/2006	47.5	41.5	8/19/2006			9/19/2006	18.3	16.5
7/20/2006	58.5	52.1	8/20/2006			9/20/2006	18.5	16.6
7/21/2006	19.1	17.1	8/21/2006			9/21/2006	7.7	6.9
7/22/2006	36.5	31.9	8/22/2006			9/22/2006	4.1	3.8
7/23/2006	34.2	29.6	8/23/2006			9/23/2006	5.9	5.5
7/24/2006	35.4	30.6	8/24/2006			9/24/2006	5.8	5.3
7/25/2006	18.3	15.9	8/25/2006			9/25/2006	6.5	5.8
7/26/2006	32.1	27.7	8/26/2006			9/26/2006	10.0	9.1
7/27/2006	42.5	36.6	8/27/2006			9/27/2006	6.8	6.3
7/28/2006	45.7	39.4	8/28/2006			9/28/2006	13.7	12.3
7/29/2006	46.5	39.6	8/29/2006			9/29/2006	17.2	15.4
7/30/2006	33.0	27.9	8/30/2006			9/30/2006	25.6	22.6
7/31/2006	45.4	39.7	8/31/2006					

TEOM Summary Statistics

July	STP	LTP
Mean	34.9	30.3
High	63.7	54.3
2nd High	58.5	52.1
Recovery	100.0%	

August	STP	LTP
Mean	35.8	31.1
High	47.6	41.6
2nd High	39.4	34.0
Recovery	19.4%	

September	STP	LTP
Mean	17.4	15.5
High	56.8	49.4
2nd High	43.9	37.9
Recovery	73.3%	

3rd Quarter 2006

	STP	LTP
Mean	28.5	24.9
High	63.7	54.3
2nd High	58.5	52.1
Recovery	64.1%	

PM_{10} Precision, Automated Method

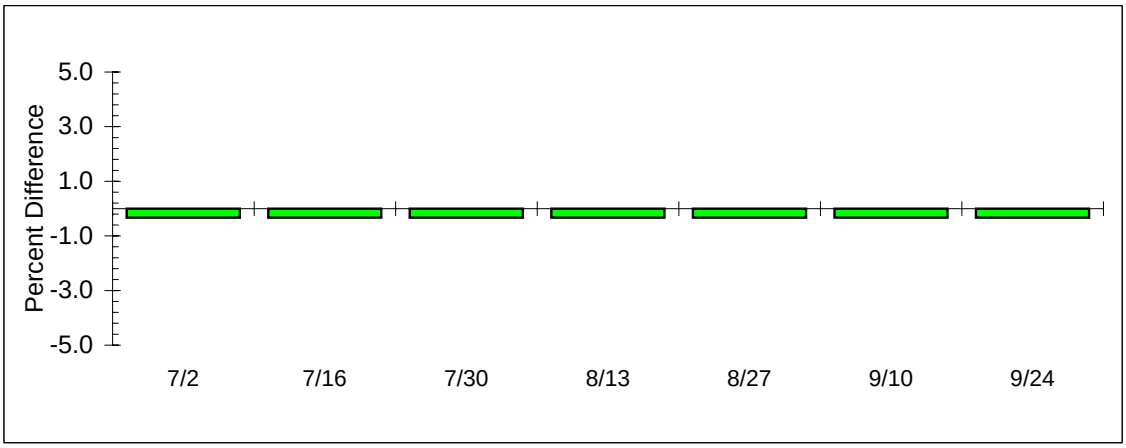
Site: Buckskin North
Instrument: R&P 1400a TEOM

3rd Quarter 2006

Mass Sensor Flow Rate (liters/minute)

Date	7/2	7/16	7/30	8/13	8/27	9/10	9/24
Design Flow	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Indicated Hourly Average Flow	2.99	2.99	2.99	2.99	2.99	2.99	2.99
%Diff.	**-0.3**	**-0.3**	**-0.3**	**-0.3**	**-0.3**	**-0.3**	**-0.3**

Percent Difference = ((Y - X) / X) * 100 X = Design Flow Y = Indicated Hourly Average Flow



Statistical Calculations

n=	7		Upper 95% Probability Limit=	-0.3	%
Sum=	-2.3	%	Lower 95% Probability Limit=	-0.3	%
Mean =	-0.3	%			
S Dev=	0	%			

Reference: 40 CFR 58, Appendix A, Sections 3.1 & 5.1
Precision of Automated Methods Excluding $PM_{2.5}$, Alternative Procedure

PM_{10} Precision, Automated Method

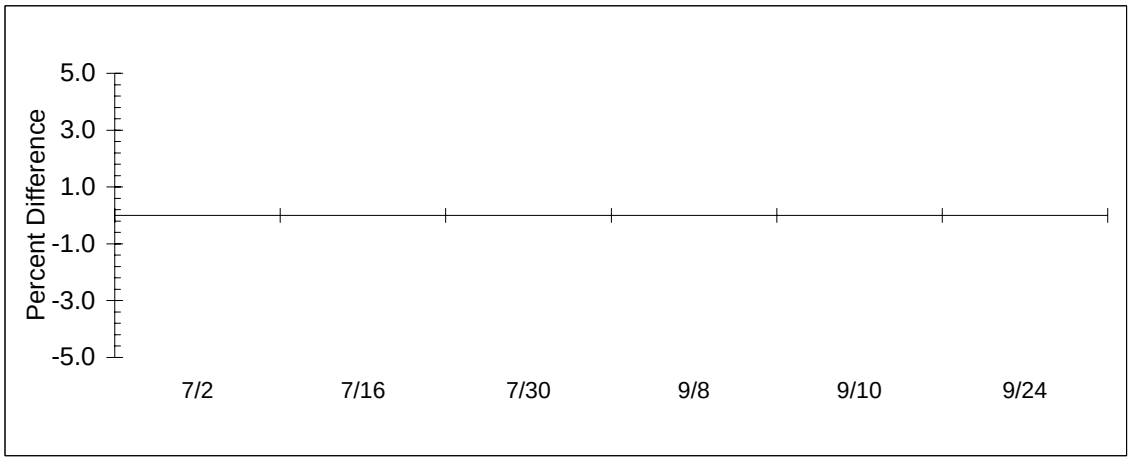
Site: Buckskin West
Instrument: R&P 1400a TEOM

3rd Quarter 2006

Mass Sensor Flow Rate (liters/minute)

Date	7/2	7/16	7/30	9/8	9/10	9/24
Design Flow	3.00	3.00	3.00	3.00	3.00	3.00
Indicated Hourly Average Flow	3.00	3.00	3.00	3.00	3.00	3.00
%Diff.	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Percent Difference = ((Y - X) / X) * 100 X = Design Flow Y = Indicated Hourly Average Flow



Statistical Calculations

n=	6		Upper 95% Probability Limit=	0.0	%
Sum=	0.0	%	Lower 95% Probability Limit=	0.0	%
Mean =	0.0	%			
S Dev=	0	%			

Reference: 40 CFR 58, Appendix A, Sections 3.1 & 5.1
Precision of Automated Methods Excluding $PM_{2.5}$, Alternative Procedure

Appendix B

Meteorological Data

Quarterly Meteorological Summaries
Quarterly Wind Rose

Buckskin Mine

Meteorological Data Summary

7/1/2006 - 9/30/2006

Hourly Data

	Average/Total	Max	Min
Wind Speed (mph)	10.2	34.4	0.6
Sigma-Theta (°)	14.7	71.5	2.2
Temperature (F)	67.5	103.1	31.8
Precipitation (in)	4.59	1.04	

Predominant wind direction was from the SSE sector,
accounting for 15.4% of the possible winds

Data Recovery

Parameter	Possible (hours)	Reported (hours)	Recovery
Wind Speed	2208	2206	99.91%
Wind Direction	2208	2206	99.91%
Sigma-Theta	2208	2206	99.91%
Temperature	2208	2202	99.73%
Precipitation	2208	2206	99.91%

Buckskin Mine

Meteorological Data Summary

7/1/2006 - 7/31/2006

Hourly Data

	Average/Total	Max	Min
Wind Speed (mph)	10.0	29.4	0.8
Sigma-Theta (°)	17.2	71.5	2.4
Temperature (F)	76.9	103.1	52.4
Precipitation (in)	0.34	0.12	

Predominant wind direction was from the SSE sector,
accounting for 12.4% of the possible winds

Data Recovery

Parameter	Possible (hours)	Reported (hours)	Recovery
Wind Speed	744	744	100.00%
Wind Direction	744	744	100.00%
Sigma-Theta	744	744	100.00%
Temperature	744	741	99.60%
Precipitation	744	744	100.00%

Buckskin Mine

Meteorological Data Summary

8/1/2006 - 8/31/2006

Hourly Data

	Average/Total	Max	Min
Wind Speed (mph)	10.1	34.4	0.6
Sigma-Theta (°)	14.5	61.0	2.3
Temperature (F)	69.9	94.8	44.8
Precipitation (in)	2.72	1.04	

Predominant wind direction was from the SSE sector,
accounting for 19.3% of the possible winds

Data Recovery

Parameter	Possible (hours)	Reported (hours)	Recovery
Wind Speed	744	742	99.73%
Wind Direction	744	742	99.73%
Sigma-Theta	744	742	99.73%
Temperature	744	741	99.60%
Precipitation	744	742	99.73%

Buckskin Mine

Meteorological Data Summary

9/1/2006 - 9/30/2006

Hourly Data

	Average/Total	Max	Min
Wind Speed (mph)	10.6	28.4	1.6
Sigma-Theta (°)	12.4	64.2	2.2
Temperature (F)	55.4	91.0	31.8
Precipitation (in)	1.53	0.08	

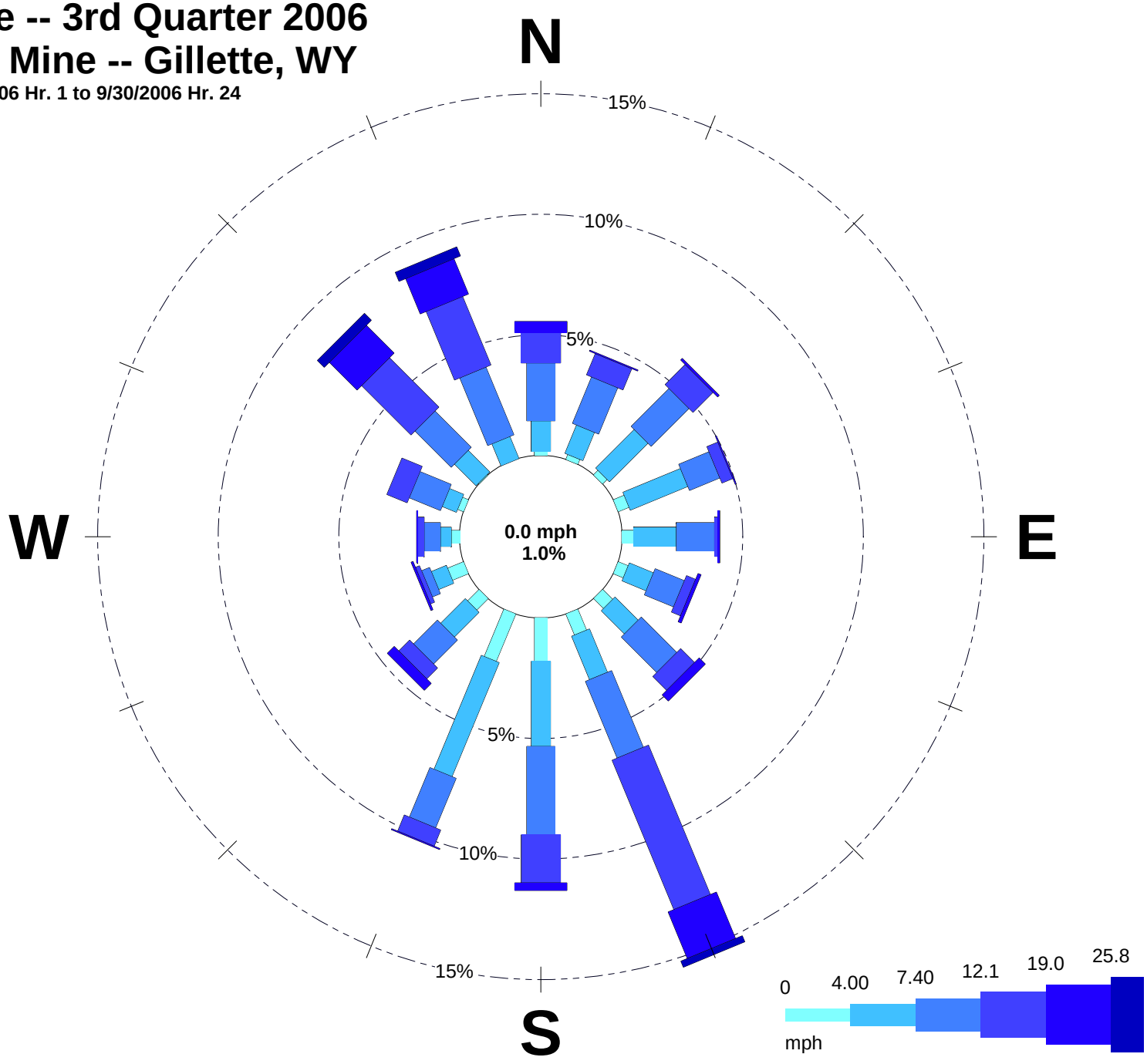
Predominant wind direction was from the NW sector,
accounting for 15.3% of the possible winds

Data Recovery

Parameter	Possible (hours)	Reported (hours)	Recovery
Wind Speed	720	720	100.00%
Wind Direction	720	720	100.00%
Sigma-Theta	720	720	100.00%
Temperature	720	720	100.00%
Precipitation	720	720	100.00%

Wind Rose -- 3rd Quarter 2006
Buckskin Mine -- Gillette, WY

7/1/2006 Hr. 1 to 9/30/2006 Hr. 24



Wind Rose -- 3rd Quarter 2006
Buckskin Mine -- Gillette, WY
7/1/2006 Hr. 1 to 9/30/2006 Hr. 24

RELATIVE FREQUENCY (% of Recorded Winds) TABLE

mph

Wind Direction	0.0- 4.0	4.0- 7.4	7.4-12.1	12.1-19.0	19.0-25.8	25.8-100.0	Row Total
0.0 deg.(North)	0.2	1.3	2.4	1.3	0.5		5.6
22.5 deg.	0.2	1.3	2.1	1.0	0.0		4.6
45.0 deg.	0.3	2.3	2.2	1.2	0.1		6.0
67.5 deg.	0.5	2.6	1.4	0.5	0.0		5.0
90.0 deg.	0.5	1.8	1.6	0.1	0.1		4.1
112.5 deg.	0.5	1.1	1.3	0.4	0.1		3.4
135.0 deg.	0.6	1.4	2.1	0.8	0.4		5.2
157.5 deg.	1.0	1.9	3.4	6.7	2.1	0.3	15.4
180.0 deg.	1.8	3.5	3.7	2.0	0.3		11.3
202.5 deg.	2.1	5.1	2.2	0.7	0.0		10.2
225.0 deg.	0.7	1.5	1.4	0.6	0.4		4.6
247.5 deg.	0.7	0.7	0.4	0.2	0.1		2.0
270.0 deg.	0.4	0.5	0.7	0.3	0.0		1.8
292.5 deg.	0.3	0.6	1.4	0.9			3.2
315.0 deg.	0.0	1.3	2.1	2.9	1.6	0.4	8.4
337.5 deg.		1.0	3.0	3.1	1.6	0.4	9.1
	9.7	27.7	31.4	22.7	7.4	1.1	100.0

0 mph (1.0%) INVALID READINGS 2

NUMBER OF POSSIBLE READINGS 2208 VALID READINGS 2206 DATA CAPTURE 99.91%

Appendix C

Quality Assurance Audits

iml Air Science
a division of Inter-Mountain Laboratories, Inc. 555 Absaraka, Sheridan, WY 82801

TEOM Audit/Calibration

Network:	Buckskin
Date:	8/1/2006
Sampler ID: (SN# 23159)	N-TEOM
Current Software Version:	3.912
QA/Serviced by:	K. Jahnke & S.Engel
Time instrument off line:	1100 MST
Notes on instrument as found: Installed new pump fan	

Parameter	Initial Values	
Filter Loading	28%	
Fadj Main	1.000	
Fadj Aux	1.010	
Case Temp	50.00	
Air Temp	50.00	
Cap Temp	49.99	
RS232 Mode	AU	
T - A/S	99.00	25.00
P - A/S	9.000	1.000
Storage Interval	3600	
Station ID	48048052	
Storage Var 1 & 2	01-STD MC	01-Hr MC
Storage Var 3 & 4	24-STD MC	24-Hr MC
Storage Var 5 & 6	Main Flow	Aux Flow
Storage Var 7 & 8	Status	Pres Drop

Standards

Manometer:	IML 0990
Temperature Standard:	IML 0915
Barometric Pressure Standard:	IML 0904
High flow FTS serial #:	010721
Low flow FTS serial #:	000299

FTS eqn: $$Qa = \mathbf{m} \times \left(\sqrt{\frac{(\Delta P \cdot T_a)}{P_a}} \right) + \mathbf{b}$$

Qa: l/min T_a: Kelvin
DP: " H_20 P_a: atmospheres

where: **m** (high flow) = 0.3933 **m** (low flow) = 0.0897
b (high flow) = -0.4415 **b** (low flow) = 0.2573

Audit

Sensor	Indicated	DP	Actual	Difference	Specification
Temperature	18.3		18.7	**0.4**	± 2.0 °C
Pressure	0.846	**25.49**	0.851	**0.005**	± 0.020 atm
Total Flow	16.63	5.46	16.57	**0.06**	± 1 l/min (for 16.7 l/min)
Main Flow	2.99	3.58	2.88	**0.11**	± 0.12 l/min (for 3.0 l/min)

Leak Checks

Flow	Value	Pass/Fail	Notes
Main	0.20	Pass	164% filter loading
Auxiliary	-0.03	Pass	

Service

Inlet Serviced/Cleaned:	Yes	**In-line filter(s) replaced:**	Aux Flow
Pump rebuilt:	Rebuilt	**Flow controller orifices replaced:**	N/A
Sensor filter replaced:	Yes	**Flow controller filters replaced:**	N/A
Other service:			

Post Service Leak Checks

Flow	Value	Pass/Fail	Notes
Main	0.18	Pass	163% Filter Loading
Auxiliary	-0.01	Pass	

Post Service Operational Checks

Sensor	Indicated	DP	Actual	Difference	Specification
Temperature	19.8		19.9	**0.1**	± 2.0 °C
Pressure	0.848	**25.49**	0.851	**0.003**	± 0.020 atm
Total Flow	16.63	5.50	16.66	**0.03**	± 1 l/min (for 16.7 l/min)
Main Flow	2.99	3.80	2.98	**0.01**	± 0.12 l/min (for 3.0 l/min)

Calibration

Sensor	Hardware Adjusted?	Final Indicated	Final Actual	Calibration FTS(s)		
Temperature	No	19.8	19.9	High Flow	m=	0.3954
Pressure	No	0.848	0.851	021001	b=	-0.3174
Fadj Main	Yes	2.99	2.99	Low Flow	m=	0.1082
Fadj Aux	Yes	16.64	16.7	021099	b=	-0.2634

Mass Transducer Calibration Verification

Actual K_0	Filter Mass	Audit K_0	% Difference	Specification	Notes
15259	0.114842	15020	1.56	< 2.5%	Pass

Time instrument returned on line: 1122 MST

Notes, comments: Left consumables kit, TEOM fan & installed rebuilt TEOM pum

Parameter	Final Values	
Filter Loading	26%	
Fadj Main	0.993	
Fadj Aux	1.016	
Case Temp	50.00	
Air Temp	51.66 dropping	
Cap Temp	50.01	
RS232 Mode	AU	
T - A/S	99.00	25.00
P - A/S	9.000	1.000
Storage Interval	3600	
Station ID	48048052	
Storage Var 1 & 2	01-STD MC	01-Hr MC
Storage Var 3 & 4	24-STD MC	24-Hr MC
Storage Var 5 & 6	Main Flow	Aux Flow
Storage Var 7 & 8	Status	Pres Drop

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TEOM Audit/Calibration

Network:	Buckskin
Date:	8/1/2006
Sampler ID: (SN# 23159)	W-TEOM
Current Software Version:	3.912
QA/Serviced by:	K. Jahnke & S.Engel
Time instrument off line:	1142 MST
Notes on instrument as found:	TEOM fan bad
Cal Constant: 13143	
Serial No.: 23159	

Parameter	Initial Values	
Filter Loading	62%	
Fadj Main	0.966	
Fadj Aux	0.987	
Case Temp	49.98	
Air Temp	50.00	
Cap Temp	49.98	
RS232 Mode	AU	
T - A/S	99.00	25.00
P - A/S	9.000	1.000
Storage Interval	3600	
Station ID	48048051	
Storage Var 1 & 2	01-STD MC	01-Hr MC
Storage Var 3 & 4	24-STD MC	24-Hr MC
Storage Var 5 & 6	Main Flow	Aux Flow
Storage Var 7 & 8	Status	Pres Drop

Standards

Manometer:	IML 0990
Temperature Standard:	IML 0915
Barometric Pressure Standard:	IML 0904
High flow FTS serial #:	010721
Low flow FTS serial #:	000299

FTS eqn: $$Qa = \mathbf{m} \times \left(\sqrt{\frac{(\Delta P \cdot T_a)}{P_a}} \right) + \mathbf{b}$$

Qa: l/min T_a: Kelvin
DP: " H_20 P_a: atmospheres

where: **m** (high flow) = 0.3933 **m** (low flow) = 0.0897
b (high flow) = -0.4415 **b** (low flow) = 0.2573

Audit

Sensor	Indicated	DP	Actual	Difference	Specification
Temperature	19.6		20.8	**1.2**	± 2.0 °C
Pressure	0.852	**25.45**	0.850	**0.002**	± 0.020 atm
Total Flow	16.64	5.50	16.70	**0.06**	± 1 l/min (for 16.7 l/min)
Main Flow	3.00	3.96	3.06	**0.06**	± 0.12 l/min (for 3.0 l/min)

Leak Checks

Flow	Value	Pass/Fail	Notes
Main	0.02	Pass	149% filter loading
Auxiliary	-0.07	Pass	

Service

Inlet Serviced/Cleaned:	Yes	**In-line filter(s) replaced:**	No
Pump rebuilt:	Rebuilt	**Flow controller orifices replaced:**	N/A
Sensor filter replaced:	Yes	**Flow controller filters replaced:**	N/A

Other service: Pump check failed

Post Service Leak Checks

Flow	Value	Pass/Fail	Notes
Main	0.05	Pass	181% filter loading
Auxiliary	-0.06	Pass	pump check good with new pump

Post Service Operational Checks

Sensor	Indicated	DP	Actual	Difference	Specification
Temperature	23.4		24.5	**1.1**	± 2.0 °C
Pressure	0.852	**25.45**	0.850	**0.002**	± 0.020 atm
Total Flow	16.65	5.45	16.73	**0.08**	± 1 l/min (for 16.7 l/min)
Main Flow	3.00	3.91	3.06	**0.06**	± 0.12 l/min (for 3.0 l/min)

Calibration

Sensor	Hardware Adjusted?	Final Indicated	Final Actual	Calibration FTS(s)	
Temperature					
Pressure					
Fadj Main					
Fadj Aux					

Mass Transducer Calibration Verification

Actual K_0	Filter Mass	Audit K_0	% Difference	Specification	Notes
13143	0.114842	13020	0.93	< 2.5%	Pass

Time instrument returned on line: 1217 MST

Notes, comments: Replaced Teom Fan & TEOM pump

Parameter	Final Values	
Filter Loading	20%	
Fadj Main	0.966	
Fadj Aux	0.987	
Case Temp	50.01	
Air Temp	52.30 Dropping	
Cap Temp	50.04	
RS232 Mode	AU	
T - A/S	99.00	25.00
P - A/S	9.000	1.000
Storage Interval	3600	
Station ID	48048051	
Storage Var 1 & 2	01-STD MC	01-Hr MC
Storage Var 3 & 4	24-STD MC	24-Hr MC
Storage Var 5 & 6	Main Flow	Aux Flow
Storage Var 7 & 8	Status	Pres Drop

iml Air Science
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TEOM Audit/Calibration

Network:	Buckskin
Date:	9/6/2006
Sampler ID: (SN# 23159)	W-TEOM
Current Software Version:	3.912
QA/Serviced by:	K. Jahnke
Time instrument off line:	1142 MST
Notes on instrument as found:	
Cal Constant: 13143	
Serial No.: 23159	
REMOVED FOR SERVICE	

Parameter	Initial Values	
Filter Loading	42%	
Fadj Main	0.966	
Fadj Aux	0.987	
Case Temp	50.00	
Air Temp	50.00	
Cap Temp	50.00	
RS232 Mode	AU	
T - A/S	99.00	25.00
P - A/S	9.000	1.000
Storage Interval	3600	
Station ID	48048051	
Storage Var 1 & 2	01-STD MC	01-Hr MC
Storage Var 3 & 4	24-STD MC	24-Hr MC
Storage Var 5 & 6	Main Flow	Aux Flow
Storage Var 7 & 8	Status	Pres Drop

Standards

Manometer:	IML 0990
Temperature Standard:	IML 0915
Barometric Pressure Standard:	IML 0904
High flow FTS serial #:	010721
Low flow FTS serial #:	000299

FTS eqn: $$Qa = \mathbf{m} \times \left(\sqrt{\frac{(\Delta P \cdot T_a)}{P_a}} \right) + \mathbf{b}$$

Qa: l/min T_a: Kelvin
DP: " H_20 P_a: atmospheres

where: **m** (high flow) = 0.3933 **m** (low flow) = 0.0897
b (high flow) = -0.4415 **b** (low flow) = 0.2573

Audit

Sensor	Indicated	DP	Actual	Difference	Specification
Temperature				**0.0**	± 2.0 °C
Pressure				**0.000**	± 0.020 atm
Total Flow				**0.00**	± 1 l/min (for 16.7 l/min)
Main Flow				**0.00**	± 0.12 l/min (for 3.0 l/min)

Leak Checks

Flow	Value	Pass/Fail	Notes
Main			
Auxiliary			

Service

Inlet Serviced/Cleaned:	**In-line filter(s) replaced:**
Pump rebuilt:	**Flow controller orifices replaced:**
Sensor filter replaced: Yes	**Flow controller filters replaced:**
Other service:	

Post Service Leak Checks

Flow	Value	Pass/Fail	Notes
Main	0.06	Pass	177% filter loading
Auxiliary	-0.07	Pass	pump check good

Post Service Operational Checks

Sensor	Indicated	DP	Actual	Difference	Specification
Temperature	25.6		26.8	**1.2**	± 2.0 °C
Pressure	0.856	**25.57**	0.857	**0.001**	± 0.020 atm
Total Flow	16.61	5.14	16.23	**0.38**	± 1 l/min (for 16.7 l/min)
Main Flow	3.00	3.68	2.96	**0.04**	± 0.12 l/min (for 3.0 l/min)

Calibration

Sensor	Hardware Adjusted?	Final Indicated	Final Actual	Calibration FTS(s)	
Temperature	No	25.8	26.4	High flow	m= 0.3954
Pressure	No	0.856	0.856	021001	b= -0.3174
Fadj Main	N/A	N/A	N/A		
Fadj Aux	Yes	16.61	16.68		

Mass Transducer Calibration Verification

Actual K_0	Filter Mass	Audit K_0	% Difference	Specification	Notes

Time instrument returned on line: 1107 MST

Notes, comments: **Installed new processor board**

Parameter	Final Values	
Filter Loading	17%	
Fadj Main	0.966	
Fadj Aux	1.025	
Case Temp	45.64 & increasing	
Air Temp	51.19 & dropping	
Cap Temp	48.77 & increasing	
RS232 Mode	AU	
T - A/S	99.00	25.00
P - A/S	9.000	1.000
Storage Interval	3600	
Station ID	48048051	
Storage Var 1 & 2	01-STD MC	01-Hr MC
Storage Var 3 & 4	24-STD MC	24-Hr MC
Storage Var 5 & 6	Main Flow	Aux Flow
Storage Var 7 & 8	Status	Pres Drop

Appendix D

Transfer Standard Certifications

Certificate of Calibration

Streamline™ flow transfer standard (FTS) # 000299
was calibrated against NIST traceable critical flow
venturis sn10961, sn10962, sn10963 on: 2/13/2006

This calibration expires: ***2/13/2007*** ***r5***

The actual flow rate (Q_a) through the FTS is:

$$Qa = \left[m \times \left(\sqrt{\frac{(\Delta P)(T_{amb})}{(P_{amb})}} \right) \right] + b$$

m= 0.0897
b= -0.2573

Q_a = actual flow rate in liters/minute

ΔP = pressure reading from the manometer in "H_2O

T_{amb} = ambient temperature in Kelvins

P_{amb} = ambient pressure in atmospheres*

* 1 atmosphere = 760 mmHg, = 29.92"Hg, =101,325 Pa

Reviewed: RLS Date: 2/13/2006

Quality Assurance Check

Primary Standard Q_{actual} (l/min)	Streamline FTS ΔP ("H_2O)	Streamline FTS $Q_{line\ fit}$ (l/min)	Absolute Difference (l/min)	% Difference* full scale
6.00	14.24	6.01	0.01	0.09%
5.07	10.30	5.07	0.00	-0.08%
4.15	7.00	4.13	-0.02	-0.29%
3.23	4.42	3.23	0.00	0.00%
2.31	2.43	2.33	0.02	0.29%
1.40	1.03	1.42	0.02	0.40%
0.49	0.19	0.47	-0.02	-0.41%

T_a (°C)= 22.1
Pa (atm)= 0.863 r= 1.0000

*all points must be within ±2%

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Streamline™ FTS, US Patent #5792966

Certificate of Calibration

Streamline™ flow transfer standard (FTS) # 010721
was calibrated against NIST traceable critical flow
venturis sn10961, sn10962, sn10963 on: 2/15/2006

This calibration expires: ***2/15/2007*** ***r8***

The actual flow rate (Q_a) through the FTS is:

$$Qa = \left[m \times \left(\sqrt{\frac{(\Delta P)(T_{amb})}{(P_{amb})}} \right) \right] + b$$

m= 0.3933
b= -0.4415

Q_a = actual flow rate in liters/minute

ΔP = pressure reading from the manometer in "H_2O

T_{amb} = ambient temperature in Kelvins

P_{amb} = ambient pressure in atmospheres*

* 1 atmosphere = 760 mmHg, = 29.92"Hg, =101,325 Pa

Reviewed: RLS Date: 2/15/2006

Quality Assurance Check

Primary Standard Q_{actual} (l/min)	Streamline FTS ΔP ("H_2O)	Streamline FTS $Q_{line\ fit}$ (l/min)	Absolute Difference (l/min)	% Difference* full scale
20.01	7.97	20.03	0.02	0.12%
17.49	6.11	17.49	0.00	-0.01%
14.98	4.51	14.97	-0.01	-0.04%
12.47	3.17	12.47	0.01	0.03%
9.97	2.04	9.92	-0.06	-0.28%
7.47	1.19	7.46	-0.01	-0.05%
4.99	0.57	5.03	0.05	0.23%

T_a (°C)= 22.1
Pa (atm)= 0.868 r= 1.0000

*all points must be within ±2%

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Streamline™ FTS, US Patent #5792966

Certificate of Calibration

Streamline™ flow transfer standard (FTS) # 021001
was calibrated against NIST traceable critical flow
venturis sn10961, sn10962, sn10963 on: 2/15/2006

This calibration expires: ***2/15/2007*** ***r3***

The actual flow rate (Q_a) through the FTS is:

$$Qa = \left[m \times \left(\sqrt{\frac{(\Delta P)(T_{amb})}{(P_{amb})}} \right) \right] + b$$

m= 0.3954
b= -0.3174

Q_a = actual flow rate in liters/minute

ΔP = pressure reading from the manometer in "H_2O

T_{amb} = ambient temperature in Kelvins

P_{amb} = ambient pressure in atmospheres*

* 1 atmosphere = 760 mmHg, = 29.92"Hg, =101,325 Pa

Reviewed: RLS Date: 2/15/2006

Quality Assurance Check

Primary Standard Q_{actual} (l/min)	Streamline FTS ΔP ("H_2O)	Streamline FTS $Q_{line\ fit}$ (l/min)	Absolute Difference (l/min)	% Difference* full scale
20.02	7.80	20.05	0.03	0.13%
17.50	5.96	17.49	0.00	-0.02%
14.99	4.40	14.98	-0.01	-0.04%
12.48	3.08	12.48	0.00	0.01%
9.98	1.97	9.93	-0.05	-0.23%
7.48	1.14	7.46	-0.02	-0.10%
4.98	0.54	5.03	0.05	0.25%

T_a (°C)= 22.2
Pa (atm)= 0.868 r= 1.0000

*all points must be within ±2%

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Streamline™ FTS, US Patent #5792966

Certificate of Calibration

Streamline™ flow transfer standard (FTS) # 021099
was calibrated against NIST traceable critical flow
venturis sn10961, sn10962, sn10963 on: 2/13/2006

This calibration expires: ***2/13/2007*** ***r4***

The actual flow rate (Q_a) through the FTS is:

$$Qa = \left[m \times \left(\sqrt{\frac{(\Delta P)(T_{amb})}{(P_{amb})}} \right) \right] + b$$

m= 0.1082
b= -0.2634

Q_a = actual flow rate in liters/minute

ΔP = pressure reading from the manometer in "H_2O

T_{amb} = ambient temperature in Kelvins

P_{amb} = ambient pressure in atmospheres*

* 1 atmosphere = 760 mmHg, = 29.92"Hg, =101,325 Pa

Reviewed: RLS Date: 2/13/2006

Quality Assurance Check

Primary Standard Q_{actual} (l/min)	Streamline FTS ΔP ("H_2O)	Streamline FTS $Q_{line\ fit}$ (l/min)	Absolute Difference (l/min)	% Difference* full scale
6.01	9.77	6.00	-0.01	-0.17%
5.08	7.08	5.06	-0.01	-0.21%
4.15	4.86	4.15	0.00	-0.02%
3.23	3.08	3.25	0.02	0.29%
2.31	1.69	2.34	0.03	0.44%
1.40	0.71	1.42	0.02	0.35%
0.49	0.13	0.45	-0.04	-0.67%

T_a (°C)= 22.2
Pa (atm)= 0.862 r= 0.9999

*all points must be within ±2%

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Streamline™ FTS, US Patent #5792966

Appendix E

West TEOM Lost Data Explanation

Buckskin Explanation:

The West TEOM station lost approximately 30 days of data during the 3rd Quarter of 2006 from August 7th to September 7th due to a faulty radio, probably resulting from a lightning strike during an August 7th storm. Kevin Jahnke, our field service technician with IML, assured me that the TEOM was still able to collect data but was unable to report that data to my office. Throughout the month of August, Kevin and I worked together, troubleshooting, to get the TEOM radio to relay data. Unfortunately, on September 5th Kevin notified me that we would have to replace the radio and all data not already reported to my office computer would be lost. I emailed Cara Keslar with WDEQ Air Quality Division that same day to notify her of the problem and she requested we provide an explanation for the lost data. We replaced the radio on August 7th and it has been functioning correctly since.

Aaron Gunderson

Engineer, Buckskin Mine

IML Explanation:

Buckskin contacted Kevin Jahnke, IML service technician, about the TEOM not downloading. Kevin thought that it was the radio not working, so Tim Mendenhall sent him a replacement. Kevin went out to the site to replace the radio, and in doing so, discovered that the problem was not the radio, it was the TEOM. The TEOM was running and collecting data, but the RS232 communications would not work, so the data could not be downloaded. We contacted Thermo, and they indicated that the problem was with the CPU board and that the RS232 communications were built into that board, so there was no way retrieve the data.

Tim Mendenhall

IML