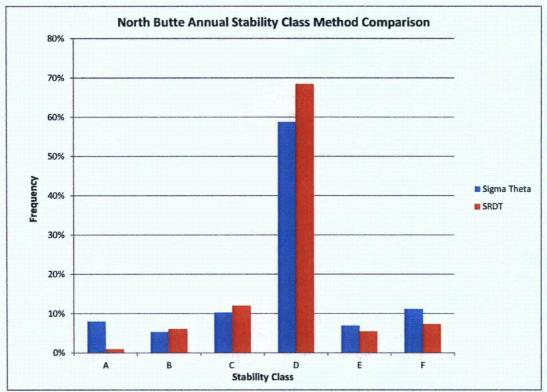
Atmospheric Stability Class

The σ_{θ} method was used to determine the Pasquill-Gifford stability class, where σ_{θ} refers to the standard deviation of the horizontal wind azimuth angle in degrees. This method is also referred to as the σ_A method (EPA 2000). It is a lateral turbulence-based method which uses the standard deviation of the wind direction in combination with the scalar mean horizontal wind speed. Wind speed and direction data are recorded hourly at a height of 10 meters. To minimize the effects of wind meander, the 1-hour σ_{θ} is defined using 15-minute σ_{θ} values which are in turn based on more frequent sampling of wind direction (e.g. every five seconds).

According to this method, initial stability classes are assigned based solely on standard deviation of wind direction, or σ_{θ} . The initial assignments are then adjusted for horizontal wind speed. The magnitude of this adjustment depends on whether the measurement is taken during daylight or nighttime hours, a diurnal dependency that varies with the time of year.

Regulatory Guide 3.63 (NRC, 1988) states: "For obtaining an indication of the atmospheric stability, a method such as one of the following (Refs. 1-4) may be used: insolation cloud cover and wind speed (Pasquill-Gifford and similar methods), temperature lapse rate method, wind fluctuation method, split-sigma method, or Richardson Number." The σ_{θ} method is based on wind fluctuation and therefore qualifies as an appropriate method for the North Butte Remote Satellite.

In order to demonstrate its reliability, a comparison was made between the σ_{θ} method and the SRDT (Solar Radiation Delta Temperature) method at the North Butte site. **Figure 2.5-24** shows this comparison. It can be seen that the two methods yield similar distributions. The percent of time characterized by stable air classes (E and F) is slightly higher for the σ_{θ} method. Given that stable air is less subject to dispersion than neutral or unstable air, it is expected that for North Butte, the σ_{θ} method will result in more conservative modeling predictions than the SRDT method.

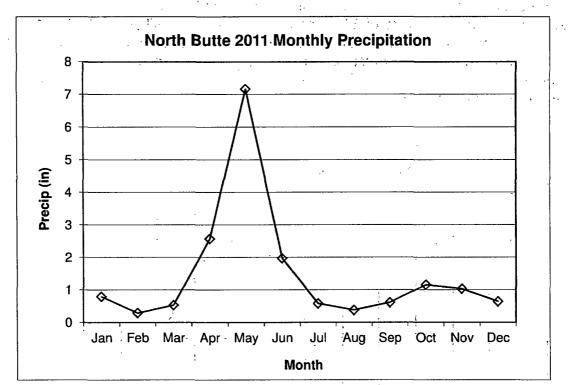


Source: Cameco Resources, 2012, data from 12/21/2010 to 1/5/2012.



Precipitation

Figure 2.5-25 shows the monthly precipitation measured at the North Butte site. Total precipitation during the baseline monitoring year was approximately 17.7 inches (approximately 450 mm), with over 40% of that falling during the month of May. Late summer and winter saw the lowest amounts of precipitation. This is about 1.5 times greater than the long term annual average precipitation measured at the Antelope Mine site from 1986 to 2012 (11.1 inches per year).

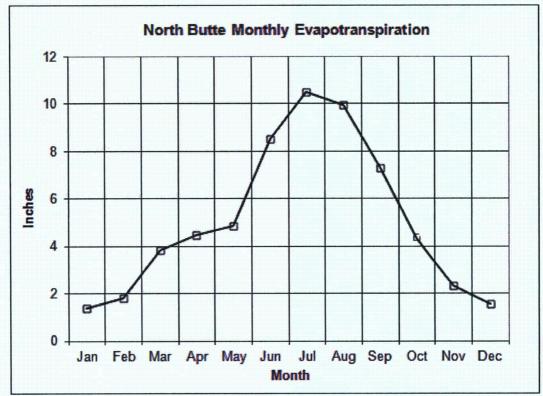


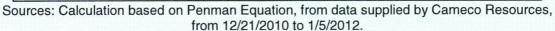
Source: Cameco Resources, 2012, data from 12/21/2010 to 1/5/2012.

Figure 2.5-25. North Butte Monthly Precipitation.

Evapotranspiration

No pan evaporation data were available at Cameco's North Butte site, so daily evapotranspiration rates were calculated using the Penman Equation. This equation uses recorded solar radiation, wind speed, temperature, and relative humidity to estimate evapotranspiration rates, which were then summed to give monthly rates. These monthly rates are shown in **Figure 2.5-26** for the baseline monitoring period. From these calculations, the annual evapotranspiration is approximately 61 inches. Excluding the months of December through March, the total becomes approximately 52 inches, which compares favorably to the long-term pan evaporation rate of 51 inches observed at the Gillette AP site 41 miles away (no pan evaporation was measured here for December through March). The North Butte evapotranspiration also shows a similar trend to the pan evaporation rates seen at Gillette AP, with higher rates observed during the warmer summer months.







Justification of Baseline Year as Representative of Long Term

The North Butte Remote Satellite is located in northeast Wyoming. The baseline meteorological monitoring period extended approximately one year, from December 21, 2010 through January 5, 2012. To demonstrate that this baseline year is representative of the longer term wind conditions, the Antelope Mine site was analyzed. Among the weather stations in the region with available data, the Antelope site was the closest to the North Butte Remote Satellite site. Antelope is approximately 36 miles southeast of the project site, with an elevation roughly 400 feet lower than North Butte. Hourly data were available at the Antelope site from January 1987 to January 2012, representing just over 25 years.

Figure 2.5-27 shows wind roses for the Antelope Mine. The left wind rose displays 25 years of monitoring, while the one on the right reflects just the time during the North Butte baseline monitoring period. These wind roses show that the wind speeds and directions are very similar between these two monitoring periods.

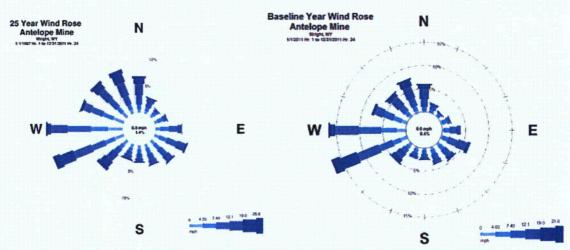
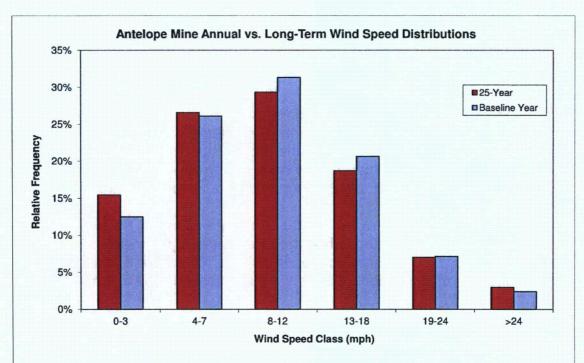


Figure 2.5-27. Antelope Mine 25-Year vs. Baseline Year Wind Roses.

Figure 2.5-28 compares the wind speed frequency distributions between the 25year and baseline periods at Antelope. The percent of the time the wind blows in each of the six wind speed categories shown is quite similar for the two monitoring periods.

Figure 2.5-29 compares the wind direction frequency distributions of the 25-year and baseline periods at Antelope. The percent of the time the wind blows from each of the sixteen wind directions shown is quite similar for the two monitoring periods.





Source: Inter-Mountain Labs, 2012, hourly data from 1987 through 2012.

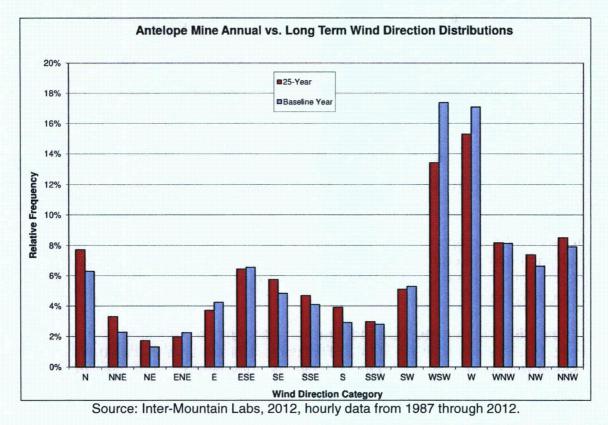


Figure 2.5-28. Antelope Mine 25-Year vs. Baseline Year Wind Speeds.

Figure 2.5-29. Antelope Mine 25-Year vs. Baseline Year Wind Directions.

In order to quantify this similarity, it is useful to isolate wind speed and wind direction variables and to correlate short-term and long-term frequency distributions. This constitutes a statistical methodology for assessing the degree to which the distributions of wind speed class and wind direction frequencies from one year of monitoring at a particular location represent the long-term distributions at that same location.

For the joint frequency wind distribution used in the MILDOS-AREA model, wind speeds are divided into six classifications ranging from mild (0 - 3 mph) to strong (> 24 mph), as illustrated in **Table 2.5-5** and **Figure 2.5-28** above. Likewise, wind directions are divided into 16 categories corresponding to the compass directions illustrated in the wind roses presented above and in **Figure 2.5-29**.

The percent of the time that winds occur in each of the six wind speed categories can be calculated to produce a wind speed frequency distribution. The percent of the time that winds blow from each of the sixteen directions can be calculated to produce a wind direction frequency distribution. For each parameter, the oneyear and 25-year distributions can then be compared. Linear regression analysis provides a useful tool to assess the degree of correlation between short and long-term distributions.

Figure 2.5-30 presents this correlation for the wind speed distributions at Antelope Mine. Each point represents one of the six wind speed classes. The x coordinate corresponds to the percent of the one-year period during which the wind speed fell in a given class, while the y coordinate corresponds to the percent of the 25-year period during which the wind speed fell in that same class.

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The regression line (red) in **Figure 2.5-30** represents the least-squares fit to the six data points. The corresponding R^2 value of 97.7% implies very strong linear correlation.

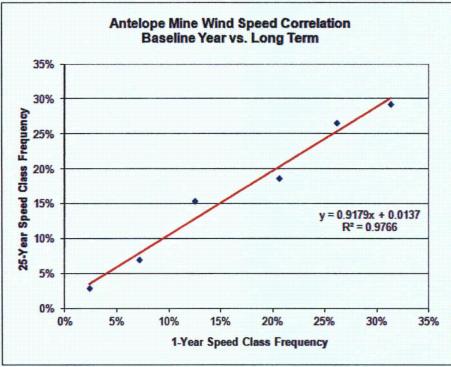
A similar analysis can be performed for wind direction frequencies. **Figure 2.5-31** presents this correlation, again for the Antelope Mine site. Each point represents one of the sixteen wind direction categories. The x coordinate corresponds to the percent of the one-year period during which the wind blew from a given direction, while the y coordinate corresponds to the percent of the 25-year period during which the wind blew from that same direction.

The regression line (red) in **Figure 2.5-31** represents the least-squares fit to the sixteen data points. The corresponding R^2 value of 95.3% implies very strong linear correlation.

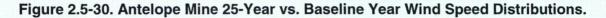
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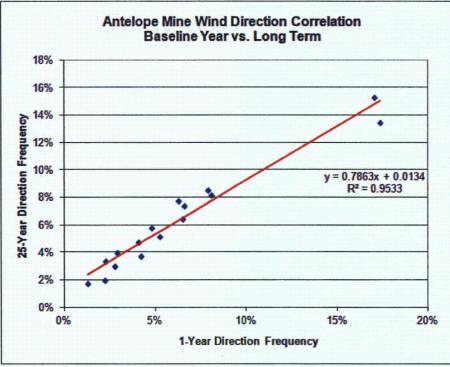
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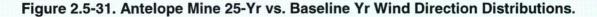


Sources: Analysis by IML Air Science using hourly data from 1987 to 2011.





Sources: Analysis by IML Air Science using hourly data from 1987 to 2011.



Figures 2.5-30 and **2.5-31** offer conclusive evidence that the 2011 baseline monitoring year adequately represents the last 25 years at Antelope Mine. Statistically, the p-value provides a measure of the probability that no linear relationship exists between the short and long-term wind data distributions. A p-value of 0 reflects the highest confidence possible that a linear relationship exists. The regression analyses of wind speed distributions and wind direction distributions both show p-values of 0.000. This result justifies a high degree of confidence that the R² values are real and that the use of baseline-year wind data to predict long-term wind behavior is legitimate.

On-Site Meteorological Instrument Specifications

Table 2.5-15 lists the meteorological instruments employed at the North Butte meteorological monitoring station. The table shows instrument models, accuracy specifications, and instrument heights above the ground. Calibration records for the meteorological instruments are contained in **Appendix A** to this document.

Meteorological data collection, management and reporting methods at the project site conform to NRC atmospheric dispersion modeling requirements for uranium milling operations, and meet the acceptance criteria established in the NRC's NUREG-1569. The on-site monitoring program was developed according to NRC Regulatory Guide 3.63, "Onsite Meteorological Measurement Program For Uranium Recovery Facilities – Data Acquisition and Reporting." Hourly average values for wind speed, wind direction, sigma theta, temperature, relative humidity, precipitation and solar radiation are generated by field instruments and recorded by continuous data loggers. Data recovery exceeded 98% for the 12-month monitoring period. All hourly data have been downloaded to a relational database for quality assurance, statistical analysis and reporting purposes.

Parameter	Measurement Method	Manufacturer and Model Number	Sampling `` Frequency	Averaging Period	Measurement Range	Instrument Reading Accuracy	Monitoring Height
Horizontal Wind Speed	Frequency	RM Young 05305-AQ	1 second	Minute/Hourly	0 – 50 m/s	±0.2 m/s	10 meters
Wind Direction	Precision potentiometer	RM Young 05305-AQ	1 second	Minute/Hourly	0 - 360°	±3° ÷	10 meters
Ambient Temperature	Thermistor	Met One 062	1 second	Minute/Hourly	-50° to +50° C	±0.05° C	10 meters
Ambient Temperature	Thermistor	Met One 062	1 second	Minute/Hourly	-50° to +50° C	±0.05° C	2 meters
Ambient Temperature	Thermistor	Vaisala HMP45C	1 second	Minute/Hourly	-45° to +60° C	±0.5° C	2 meters
Dew Point Temperature	Calculated	Calculated	Calculated	Minute/Hourly Calculated	N/A	N/A	2 meters
Differential Temperature	Calculated	Calculated	1 second	Minute/Hourly	N/A	N/A	2 -10 meters
Relative Humidity	Capacitive polymer H-chip	Vaisala HMP45C	1 second	Minute/Hourly	0.8% to 100%	±2% (0-90%RH) ±3% (90-100%RH)	2 meters
Solar Radiation	Silicon photovoltaic detector	Campbell LI200X	1 second	Minute/Hourly	0-2000 W/m ²	±5%	2 meters
Precipitation	Tipping Bucket	Texas Instruments TE525WS	Event Data	Minute/Hourly	Finite increments of, tip of rainfall	±1%	75 cm

Source: Cameco Resources, 2012

 Table 2.5-15. North Butte Monitoring Details

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Upper Atmosphere Characterization

Mixing height is the height of the atmosphere above the ground that is well mixed due either to mechanical turbulence or convective turbulence. The air layer above this height is stable. Higher mixing heights are associated with greater dispersion, all other parameters being the same. Stable periods have much lower mixing heights and accompanying lapse rates allowing for less temperature variation. The MILDOS-AREA model uses mixing height, along with other wind parameters, to predict pollutant dispersion. Unstable air leads to more dispersion, which leads to lower predicted impacts on ambient air quality. The default mixing height used by MILDOS-AREA is 100 meters, a very conservative value.

The nearest upper-air data available from the National Weather Service are from Lander, Wyoming, approximately 150 miles west of the site. Average mixing heights were derived from the AERMOD calculations used for dispersion modeling, based on hourly data obtained from the National Weather Service station in Lander (upper air). The AERMOD calculation is based on a combination of mechanically and convectively driven boundary layer processes. The results of these calculations are provided for morning and afternoon periods in **Table 2.5-16**. The 24-hour annual average mixing height is 916 meters.

Time Period (Filtered)	Average Mixing / Inversion Height
Morning (2 am – 7 am)	579 meters
Afternoon (2 pm – 7 pm)	1,123 meters

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Sources: IML computation based on data from National Climate Data Center, 2011

Table 2.5-16. Lander Mixing Heights.

The mixing or inversion heights are entered as inputs to the MILDOS-AREA model for pollutant dispersion modeling. For the North Butte Project, the MILDOS modeling run used the default mixing height of 100 meters, which is more conservative than the measured mixing heights at Lander.

Bodies of Water and Special Terrain Features

There are no significant bodies of water near the proposed North Butte project which would have an impact on meteorology.

The nearest and most dominant terrain feature is North Butte, located approximately 2 miles to the northwest. North Butte acts to shield the project area from the northwest winds found in the region and introduces some diurnal convection winds. However, the predominant winds in the region are from the west, west-southwest, and southwest, and are not affected by the proximity of the site to North Butte.

Conclusion

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The North Butte Remote Satellite in northeast Wyoming is located in a semi-arid or steppe climate. The area is characterized by abundant sunshine, low relative humidity, and sustained winds which lead to high evaporative demand. The region has large diurnal and annual variations in temperature.

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Three meteorological stations were used to characterize regional weather patterns. The region is characterized seasonally by cold winters, warm, dry summers, and cool springs and autumns. Temperature extremes range from approximately -40° F in the winter to 100° F in the summer. The region generally receives little precipitation, with annual averages between 4 and 19 inches. Spring and early summer precipitation events are responsible for the majority of the yearly average.

The region is characterized by annual average wind speeds of 9 to 12.5 mph. Winds at the North Butte site are expected to average about 10 mph annually, with summer averages dropping below 9 mph and winter and spring averages exceeding 11 mph. The predominant wind direction is from the west-southwest, with stronger western components at the Antelope Mine and stronger southwestern components in the North Butte Remote Satellite area.

The Antelope Mine meteorological station was included in the site specific analysis to validate the temporal representativeness of on-site wind data by incorporating wind monitoring results from a longer period of record. The Antelope Mine site is located 36 miles southeast of the North Butte project site. The distributions of wind speeds and directions at Antelope Mine during the baseline monitoring period have been shown to closely represent Antelope's 25year distributions of wind speeds and directions. This evidence strongly supports the assertion that winds at the North Butte project site during the baseline year of 2011 are representative of the long term.

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Appendix A

North Butte Meteorological Station Calibration Records

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		2,000	22.90	22.90	0.00	0.0		≤ ±5%	PASS	
		4,000	45.80	45.80	0.00	0.0		≤ ±5%	PASS	
		6,000	68.70	68.70	0.00	0.0		≤ ±5%	PASS	
		8,000	91.60	91.60	0.00	0.0		≤ ±5%	PASS	
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	Water Bath Ice Cool	Temp. °C 0.01 22.63	°C 0.02 22.53	2-m Error °C 0.01 -0.10	ed Data Lo Pass? Fail? PASS PASS	ogger Resp 10-m °C - 0.02 22.47	00000000000000000000000000000000000000	Pass? Fail? PASS -			a state and a state of the stat
	Water Bath Ice Cool Hot	Temp. °C 0.01 22.63 49.80	°C 0.02 22.53	2-m Error °C 0.01 -0.10 -0.37	ed Data Lo Pass? Fail? PASS PASS PASS	ogger Resp 10-m °C - 0.02 22.47	00000000000000000000000000000000000000	Pass? Fail? PASS - PASS			and the second secon
	Water Bath Ice Cool Hot	Temp. ℃ 0.01 22.63 49.80 ture Diffe	°C 0.02 22.53 49.43	2-m Error °C 0.01 -0.10 -0.37 stem Cali	ed Data Lo Pass? Fail? PASS PASS PASS bration	ogger Resp 10-m °C - 0.02 22.47	10-m Error °C 0.01 -0.16 -0.34	Pass? Fail? PASS - PASS PASS		441-	
	Wâter Bath Ice Cool Hot Tempera	Temp. °C 0.01 22.63 49.80 ture Diffe Input	°C 0.02 22.53 49.43 erence Sys	2-m Error °C -0.01 -0.10 -0.37 stem Cali	ed Data Lo Pass? Fail? PASS PASS PASS bration	ogger Resp 10-m °C - 0.02 22.47	10-m Error °C 0.01 -0.16 -0.34	Pass? Fail? PASS - PASS PASS	aths were cons		
	Water Bath Ice Cool Hot Tempera Known	Temp. °C 0.01 22.63 49.80 ture Diffe Input	°C 0.02 22.53 49.43 erence Sys Obse 2-10 ΔT	2-m Error °C -0.01 -0.37 stem Cali stem Cali 2-10 ΔT	ed Data Lo Pass? Fail? PASS PASS PASS bration	ogger Resp 10-m °C - 0.02 22.47	IO-m Error °C 0.01 -0.16 -0.34 (NOTE: T agitated	Pass? Fail? PASS PASS PASS	anical stirring d		
	Wâter Bath Ice Cool Hot Tempera Known Water Bath	Temp. °C 0.01 22.63 49.80 ture Diffe Input ΔT °C	°C 0.02 22.53 49.43 arence System 2-10 ΔT °C	2-m Error °C -0.01 -0.10 -0.37 stem Cali erved Resp 2-10 ΔT Error °C	ed Data Lo Pass? Fail? PASS PASS PASS bration oonse Pass? Fail?	ogger Resp 10-m °C - 0.02 22.47	IO-m Error °C 0.01 -0.16 -0.34 (NOTE: T agitated	Pass? Fail? PASS - PASS PASS	anical stirring d		
	Wâter Bath Ice Cool Hot Tempera Water Bath Ice	Temp. °C 0.01 22.63 49.80 ture Diffe Input ΔT °C 0.00	°С 0.02 22.53 49.43 rence Sys 2-10 ∆Т °С 0.00	2-m Error °C 0.01 -0.10 -0.37 stem Cali erved Resp 2-10 ΔT Error °C 0.00	ed Data Lo Pass? Fail? PASS PASS PASS bration ponse Pass? Fail?	ogger Resp 10-m °C - 0.02 22.47	IO-m Error °C 0.01 -0.16 -0.34 (NOTE: T agitated the calib	Pass? Fail? PASS PASS PASS	anical stirring d 5.)	luring	
	Water Bath Ice Cool Hot Tempera Known Water Bath Ice Çool	Temp. °C 0.01 22.63 49.80 ture Diffe input ΔT °C 0.00 0.00	°C 0.02 22.53 49.43 erence Sys 2-10 ΔT °C 0.00 0.00 0.06	2-m Error °C 0.01 -0.10 -0.37 stem Cali erved Resp 2-10 ΔT Error °C 0.00 - 0.06	ed Data Lo Pass? Fail? PASS PASS PASS bration PASS Pass? Fail? PASS PASS	ogger Resp 10-m °C - 0.02 22.47	ID-m Error °C 0.01 -0.16 -0.34 (NOTE: T agitated the calib (NOTE: D	Pass? Fail? PASS PASS he water b with mech ration tests	anical stirring d s.) AT calibration, b	luring both	
	Wâter Bath Ice Cool Hot Tempera Water Bath Ice	Temp. °C 0.01 22.63 49.80 ture Diffe Input ΔT °C 0.00	°С 0.02 22.53 49.43 rence Sys 2-10 ∆Т °С 0.00	2-m Error °C 0.01 -0.10 -0.37 stem Cali erved Resp 2-10 ΔT Error °C 0.00	ed Data Lo Pass? Fail? PASS PASS PASS bration ponse Pass? Fail?	ogger Resp 10-m °C - 0.02 22.47	ID-m Error °C 0.01 -0.16 -0.34 (NOTE: T agitated the calib (NOTE: D	Pass? Fail? PASS PASS he water b with mech ration tests	anical stirring d 5.)	luring both	
	Water Bath Ice Cool Hot Tempera Known Water Bath Ice Çool	Temp. °C 0.01 22.63 49.80 ture Diffe input ΔT °C 0.00 0.00	°C 0.02 22.53 49.43 erence Sys 2-10 ΔT °C 0.00 0.00 0.06	2-m Error °C 0.01 -0.10 -0.37 stem Cali erved Resp 2-10 ΔT Error °C 0.00 - 0.06 -0.03	ed Data Lo Pass? Fail? PASS PASS PASS bration PASS Pass? Fail? PASS PASS	ogger Resp 10-m °C -0.02 22.47 49.46	IO-m Error °C 0.01 -0.16 -0.34 (NOTE: T agitated the calib (NOTE: D probes w	Pass? Fail? PASS PASS he water b with mech ration tests	anical stirring d s.) AT calibration, b	luring both	
	Water Bath Ice Cool Hot Tempera Known Water Bath Ice Çool	Temp. °C 0.01 22.63 49.80 ture Diffe input ΔT °C 0.00 0.00	°C 0.02 22.53 49.43 erence Sys 2-10 ΔT °C 0.00 0.00 0.06	2-m Error °C 0.01 -0.10 -0.37 stem Cali erved Resp 2-10 ΔT Error °C 0.00 - 0.06 -0.03	ed Data Lo Pass? Fail? PASS PASS PASS PASS PASS Pass? Fail? PASS PASS PASS	ogger Resp 10-m °C -0.02 22.47 49.46	IO-m Error °C 0.01 -0.16 -0.34 (NOTE: T agitated the calib (NOTE: D probes w	Pass? Fail? PASS PASS he water b with mech ration tests	anical stirring d s.) AT calibration, b	luring both	
	Water Bath Ice Cool Hot Tempera Known Water Bath Ice Çool	Temp. °C 0.01 22.63 49.80 ture Diffe input ΔT °C 0.00 0.00	°C 0.02 22.53 49.43 erence Sys 2-10 ΔT °C 0.00 0.00 0.06	2-m Error °C 0.01 -0.10 -0.37 stem Cali erved Resp 2-10 ΔT Error °C 0.00 - 0.06 -0.03	ed Data Lo Pass? Fail? PASS PASS PASS PASS PASS Pass? Fail? PASS PASS PASS	ogger Resp 10-m °C -0.02 22.47 49.46	IO-m Error °C 0.01 -0.16 -0.34 (NOTE: T agitated the calib (NOTE: D probes w	Pass? Fail? PASS PASS he water b with mech ration tests	anical stirring d s.) AT calibration, b	luring both	
	Water Bath Ice Cool Hot Tempera Known Water Bath Ice Çool	Temp. °C 0.01 22.63 49.80 ture Diffe input ΔT °C 0.00 0.00	°C 0.02 22.53 49.43 erence Sys 2-10 ΔT °C 0.00 0.00 0.06	2-m Error °C 0.01 -0.10 -0.37 stem Cali erved Resp 2-10 ΔT Error °C 0.00 - 0.06 -0.03	ed Data Lo Pass? Fail? PASS PASS PASS PASS PASS Pass? Fail? PASS PASS PASS	ogger Resp 10-m °C -0.02 22.47 49.46	IO-m Error °C 0.01 -0.16 -0.34 (NOTE: T agitated the calib (NOTE: D probes w	Pass? Fail? PASS PASS he water b with mech ration tests	anical stirring d s.) AT calibration, b	luring both	

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		PART A	: ANCI	ILLARY I	NFORM	ATION		
Project: Nor	th Butte		Date:	12/22/2010			Ċŀ	neck One:
Location: <u>Wy</u>	oming		Start:	10:25 12/22	2/2010		As Found:	· · · V -
echnician: Eth	an Brown		End:	10:00 12/09	/2010		As Left: _	
			SENSO					
Make: LiC	or	a sata a sa				Operati	ng Range: () to 1,400 W/m ²
Model: 200) Pyranometer				H	eight Abov	e Ground: 1	.8 meters
SN: PY	57334							
		•.•		t i	1			
	-	<u>CA</u>	LIBRATIC	<u>ON TEST E</u>		NT		• •
Item: Kip	p & Zonen CM-3 p	yranometer					SN:	
	ke, Model 289, dig							96210097
	Known				d DAS Re			
	Period	Value	DAS	Error	Error	Error	Pass?	
	hhmm	W/m ²	W/m²	W/m²	%	% F.S.	Fail? ⁴	
	Covered	0.2	0	0	NA	NA	PASS	
÷ •	. 10:25	. 173	173	0	-0.2	0.0	PASS	· _·
	11:03	320	330		3.1	0.7	PASS	
	11:30	413	425	12 11	2.8	0.8	PASS	· .
	11:31	547	558		2.1	0.8	PASS	
	12:35	233	239	5	2.3	0.4	PASS	·
	L	Calibrat	ion Curve		Slope: 1	1.0259	PASS	
		Canbrat	ion curve		ntercept: ²		PASS	
					rr. Coeff: ³	1-1-1	PASS	
_				0		0.9999	FA33	
			С	OMMENT	<u> </u>			
			_					
- It was difficul	It to get a large rar	nge of value	s due to inc	reasing clo	ud cover th	nroughout t	he dav.	
	0 0	0		Ū		°	•	
To PAS	SS, the sensor m	ust have	¹ Slope = 1	.0 ±0.05			·····	<u> </u>
				= ≤ 1% of F	ull Scale			
				on Coefficie				

<u> </u>		DITY SENSOR CALIE		
<u> </u>	PARTA	A: ANCILLARY INFORM	MATION	
Project: North Butte	e	Date: 12/22/2010	Ch	eck One:
Location: Wyoming	••	Start: 11:27 12/22/2010	As Found:	\checkmark
Technician: Ethan Brow	wn	End: 10:00 12/22/2010	As Left:	·.
		SENSOR INFORMATION		
Make: Vaisala			Operating Range: 0-	
Model: HMP45AC SN: C1920086		. H	eight Above Ground: 2	neters
	<u>C/</u>	LIBRATION TEST EQUIPME	NT	
Item: Fisher Scie	entific Traceable Hygro	ometer, Thermometer, Dew Point	SN:	72366727
<u> </u>	PART B:	CALIBRATION TEST F	RESULTS	
· · ·				
		OBSERVED RESPONSE	: · ·	:
	KNOWN INPUT	DAS Error Pass?		
	Test %RH	%RH %RH Fail? ¹		
	Ambient 64.0	68.0	Į	
	Chimbr. 94.7	95.4 0.7 PÁŠS	ļ	
		COMMENTS	· · · · · ·	
		elative humidity. The Vaisala sen mber will need to be used for the		
instead of the Fisher	Scientific Hygrometer.	· ·		
		· · ·		
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PART A: ANCILLARY INFORMATION Projec: North Butte Date: 12/22/2010 As Found: / Location: Myoning End: 10/00 12/22/2010 As Found: / Technician: Ethan Brown End: 10/22/2010 As Found: / Technician: Ethan Brown End: 10/22/2010 As Left: / Technician: Meton Gauge Type: Tipping Bucket Operating Range: NA Made: Mode: TB252USW Operating Range: NA Made: Made: Toping Bucket St: 45508-1010 Meton Technician: Na Made: Toping Bucket St: 45508-1010 Matery Theight Above Ground: Top: Top: Top: Churd Matery Grade Response St: Na Matery Top: Na DAS Tror Frair? Fair? As Left: St: Na Das Tror Tror Fair? As Left: St: Na Das Tror Tror Fair? As Left: <t< th=""><th></th><th></th><th></th><th></th><th></th><th></th><th></th></t<>							
Location: Wyoming Start: 9:00 12/22/2010 As Found: √ Technician: Ethan Brown End: 10:00 12/22/2010 As Left:		PART A	: ANCIL	LARY	INFORN	<i>IATION</i>	
Technician: Ethan Brown End: 10:00 12/22/2010 As Left:	Project: North Butte		Date: 1	2/22/2010			Check One:
Make: Met One Gauge Type: Tipping Bucket Model: TR5250SW Operating Range: NA SN: 45508-1010 Height Above Ground: 76.20 cm CALIBRATION TEST EQUIPMENT Item: Distilled water, graduated cylinders, drip device SN: NA PART B: CALIBRATION TEST RESULTS Meters part of the server pass? Make: OBSERVED RESPONSE Min. Make: Make: Make: Tip Acity of the server pass? Min. Make: Make: Make: Tip Acity of the server pass?	Location: Wyoming		Start: 9	:00 12/22/	2010		As Found:√
Make: Met One Gauge Type: Tipping Bucket Model: TR525USW Operating Range: NA SN: 45508-1010 Height Above Ground: 76.20 cm CALIBRATION TEST EQUIPMENT Item: Distilled water, graduated cylinders, drip device SN: NA PART B: CALIBRATION TEST RESULTS OBSERVED RESPONSE Min. Max Max MA OBSERVED RESPONSE Min. Max Max Ma	Technician: Ethan Brown		End: <u>1</u>	0:00 12/22	2/2010		As Left:
Model: TR525USW Operating Range: NA SN: 45508-1010 Height Above Ground: 76.20 cm CALIBRATION TEST EQUIPMENT Item: Distilled water, graduated cylinders, drip device SN: NA PART B: CALIBRATION TEST RESULTS OBSERVED RESPONSE Max Max Max CALIBRATION TEST RESULTS OBSERVED RESPONSE Mil, H ₂ O mm mm % Fail? 1 250 7.60 7.37 -0.23 -3.1 PASS			<u>SENSOR</u>		IATION		
SN: 45508-1010 Height Above Ground: 76.20 cm CALIBRATION TEST EQUIPMENT Item: Distilled water, graduated cylinders, drip device SN: NA PART B: CALIBRATION TEST RESULTS OBSERVED RESPONSE M M OBSERVED RESPONSE MI, H ₂ O mm MI, H ₂ O mm MI, H ₂ O 7.60 7.37 -0.23 -3.1 PASS	<u>+</u>						
CALIBRATION TEST EQUIPMENT Item: Distilled water, graduated cylinders, drip device SN: NA DART B: CALIBRATION TEST RESULTS OBSERVED RESPONSE MI, H ₂ O mm MI, H ₂ O 7.60 7.60 7.37 OLS Colspan="2">OLS Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2"C					11	-	
Item: Distilled water, graduated cylinders, drip device SN: NA PART B: CALIBRATION TEST RESULTS OBSERVED RESPONSE KNOWN INPUT DAS BAR BR MI, H ₂ O mm MR MR 250 7.60 7.37 -0.23 -3.1 PASS	SN: 45508-1010				H	eight Abov	e Ground: 76.20 Cff
PART B: CALIBRATION TEST RESULTS OBSERVED RESPONSE KNOWN INPUT DAS Error Fais? ml, H ₂ O mm 250 7.60 7.37 -0.23 -3.1 PASS		<u>CA</u>	LIBRATIO	N TEST E		<u>NT</u>	
OBSERVED RESPONSEKNOWN INPUTDASErrorErrorPass?ml, H2Ommmmmm%Fail? 12507.607.37-0.23-3.1PASS	Item: Distilled water, grad	luated cylinde	rs, drip devid	ce			SN: NA
OBSERVED RESPONSEKNOWN INPUTDASErrorErrorPass?ml, H2Ommmmmm%Fail? 12507.607.37-0.23-3.1PASS					TECT		·
KNOWN INPUTDASErrorErrorPass?ml, H2Ommmmmm%Fail? 12507.607.37-0.23-3.1PASS		PARI D:	CALID	ATION	12317	1ESUL I	5
ml, H ₂ O mm mm % Fail? 1 250 7.60 7.37 -0.23 -3.1 PASS			(DBSERVE	D RESPO	NSE	
250 7.60 7.37 -0.23 -3.1 PASS	KNO	WN INPUT	DAS	Error	Error	Pass?	
	ml, H ₂ 0) mm	mm	mm	%	Fail? ¹	
	250	7.60	7.37	-0.23	-3.1	PASS	
COMMENTS							
					~		·····
				JIVIIVIENT	5		
			<u>cc</u>		2		
					5		
			<u>ct</u>		<u>5</u>		
			<u>ct</u>	<u> 2101 MIEN I</u>	2		
			<u>cc</u>	<u> 2101 MIEN I</u>	2		
			<u>cc</u>	JMMENT	<u>0</u>		
			<u>c</u> .	JMMENI	<u>0</u>		
			<u></u>	JMINIENT	<u>0</u>		
			<u></u>	JMINIENI	<u>0</u>		
			<u>C(</u>	JMINIENI	<u>ە</u>		
			<u>C(</u>		<u>0</u>		
			<u>C(</u>		<u>0</u>		
			<u>C(</u>		<u>0</u>		
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			<u>C(</u>	JMINENI	<u>2</u>		
				JMINENI	<u>2</u>		
			<u>C(</u>		<u>ס</u>		

Project: North Butte Date: 07/14/2011 Check One: Location: Wyoming Start: 11:20 07/14/2011 As Found: √ schnician: Ethan Brown End: 10:55 12/22/2010 As Left:
End: 10:55 12/22/2010 As Left:
SENSOR INFORMATION Make: <u>FM Young</u> Propeller SN: Model: 05305-5 Wind Monitor - AQ Operating Range: 0 to 50 mps SN: WM106261 Height Above Ground: 10 meters CALIBRATION TEST EQUIPMENT Item: Variable motor. R.M.Young, 18820A/18830A (200 to 15,000 rpm) SN: CA032 Item: Variable motor. R.M.Young, 18820A/18831A (0 to 300 rpm) SN: CA032 Item: Variable motor. R.M.Young, 18820A/18831A (0 to 300 rpm) SN: CA032 Item: Torque disk device. R.M.Young, 18312 SN: NA PART B: CALIBRATION TEST RESULTS PART B: CALIBRATION TEST RESULTS Sensor Starting Threshold: 2.0
Make: Propeller SN:
Model: 05305-5 Wind Monitor - AQ Operating Range: 0 to 50 mps SN: WM106261 Height Above Ground: 10 meters CALIBRATION TEST EQUIPMENT Item: Variable motor. R.M.Young, 18820A/18830A (200 to 15,000 rpm) SN: CA032 Item: Variable motor. R.M.Young, 18820A/18831A (0 to 300 rpm) SN: CA032 Item: Torque disk device. R.M.Young, 18312 SN: NA PART B: CALIBRATION TEST RESULTS Sensor Starting Threshold: 2.0 ,equal to 0.38 Pass? / Fail?: Pass Motor Motor Output Error Error Limit Pass? 5 0.50 mps Motor Motor Output Error Error Limit Pass? Fail? 0.0 0.00 0.00 NA NA NA NA Motor Motor Output Error Error Limit Limit Pass? 0.0 0.00 0.00 NA NA NA NA Motor Motor Outp
SN: WM106261 Height Above Ground: 10 meters CALIBRATION TEST EQUIPMENT Item: Variable motor. R.M.Young, 18820A/18830A (200 to 15,000 rpm) SN: CA032 Item: Variable motor. R.M.Young, 18820A/18831A (0 to 300 rpm) SN: CA032 Item: Variable motor. R.M.Young, 18820A/18831A (0 to 300 rpm) SN: CA032 Item: Torque disk device. R.M.Young, 18312 SN: NA PART B: CALIBRATION TEST RESULTS Sensor Starting Threshold: 2.0 ,equal to 0.38 Pass? / Fail?: Pass Sensor Input Observed Data Logger Response So 50 mps $\leq 0.50 mps$ $\leq 0.50 mps$ Motor Motor Output Error Limit Limit Pass? 0.0 0.00 0.00 NA NA NA 300 3.44 3.44 0.00 0.1 $\leq \pm0.20$ PASS
CALIBRATION TEST EQUIPMENT Item: Variable motor. R.M.Young, 18820A/18830A (200 to 15,000 rpm) SN:CA032 Item: Variable motor. R.M.Young, 18820A/18831A (0 to 300 rpm) SN:CA032 Item: Torque disk device. R.M.Young, 18820A/18831A (0 to 300 rpm) SN:CA032 Item: Torque disk device. R.M.Young, 18312 SN:NA PART B: CALIBRATION TEST RESULTS Sensor Starting Threshold:, equal to, mps Pass? / Fail?: Pass
Item: Variable motor. R.M.Young, 18820A/18830A (200 to 15,000 rpm)SN:CA032Item: Variable motor. R.M.Young, 18820A/18831A (0 to 300 rpm)SN:CA032Item: Torque disk device. R.M.Young, 18312SN:NAPART B: CALIBRATION TEST RESULTSSensor Starting Threshold: 2.0 , equal to 0.38 mpsPass? / Fail?: Pass $\leq 0.50 \text{ mps}$ Known InputObserved Data Logger ResponseMotorMotorOutputErrorErrorImitLimitPass?Fail?0.00.000.00NANA3003.443.440.000.1 $\leq \pm 0.20$
Item: Variable motor. R.M.Young, 18820A/18831A (0 to 300 rpm)SN: CA032Item: Torque disk device. R.M.Young, 18312SN: CA032PART B: CALIBRATION TEST RESULTSSensor Starting Threshold: 2.0 gm-cm, equal to 0.38 mpsPass? / Fail?: Pass $\leq 0.50 mps$ Motor InputObserved Data Logger ResponseMotorMotorOutputErrorErrorLimitPass? Fail?0.00.000.000.000.1 $\leq \pm 0.20$ PASS
Item: Torque disk device. R.M.Young, 18312 SN: NA PART B: CALIBRATION TEST RESULTS Sensor Starting Threshold: 2.0 gm-cm , equal to 0.38 mps Pass? / Fail?: Pass ≤ 0.50 mps Known Input Observed Data Logger Response Motor Motor Output Error Error Limit Pass? Motor Motor Output Error Error Limit Pass? 0.0 0.00 0.00 0.00 NA NA 300 3.44 3.44 0.00 0.1 $\leq \pm 0.20$ PASS
PART B: CALIBRATION TEST RESULTSSensor Starting Threshold: 2.0 gm-cmequal to 0.38 mpsPass? / Fail?: Pass ≤ 0.50 mpsKnown InputObserved Data Logger ResponseMotorMotorOutputErrorErrorLimitPass? mpsMotorMotorOutputErrorErrorLimitPass? Fail?0.00.000.000.00NANANA3003.443.440.000.1 $\leq \pm 0.20$ PASS
Sensor Starting Threshold: $2.0 \\ gm-cm$, equal to $0.38 \\ mps$ Pass? / Fail?:Pass $\leq 0.50 mps$ Known InputObserved Data Logger ResponseMotorMotorOutputErrorErrorLimitPass?MotorMotorOutputErrorErrorLimitPass?0.00.000.000.00NANANA3003.443.440.000.1 $\leq \pm 0.20$ PASS
rpmmphmps%mps%Fail? 0.0 0.00 0.00 0.00 NANANA 300 3.44 3.44 0.00 0.1 $\leq \pm 0.20$ PASS
0.0 0.00 0.00 0.00 NA NA NA 300 3.44 3.44 0.00 0.1 $\leq \pm 0.20$ PASS
300 3.44 3.44 0.00 0.1 $\leq \pm 0.20$ PASS
1,000 11.45 11.45 0.00 0.0 $\leq \pm 5\%$ PASS
2,00022.9022.900.000.0 $\leq \pm 5\%$ PASS4,00045.8045.800.000.0 $\leq \pm 5\%$ PASS
4,00045.8045.800.000.0 $\leq \pm 5\%$ PASS6,00068.7068.700.000.0 $\leq \pm 5\%$ PASS
$6,000$ 68.70 0.00 0.0 $$ $\leq \pm 5\%$ PASS $8,000$ 91.60 91.00 0.0 $$ $\leq \pm 5\%$ PASS

			PART	A: ANÇ	ILLARY	INFORM	MATION		
Project:	North Butte	9		Date:	07/14/2011		_	(Check One:
Location:	Wyoming	· .		Start:	11:20 07/14	4/2011		As Found:	<u> </u>
echnician:	Ethan Brov	<u>wn</u>		End:	10:55 12/22	2/2010	-	As Left:	· · ·
				<u>SENSO</u>	R INFORM	<u>ATION</u>			
Make:	RM Young	. 1		_	• •	••	Pro	peller SN:	
Model:	05305-5 W	/ind Monito	r - AQ	_			Operati	ng Range:	0 to 50 mps
SN:	WM10626	1		-		H			10 meters
			<u>C/</u>		<u>ON TEST E</u>		<u>INT</u>		
Item:	Brunton po	ocket transi	t compass			. •.		SN:	5080610049
ltem:	R.M.Young	g, Model 18	331, vane	torque mea	asurement d	evice		SN:	NA
Item:	R.M.Young	g, Model 18	112, vane	angle fixtu	re			SN:	NA
			•	Thittp://www.	nade noss ac	vilgeomagn		ation len)	···
	Senso	r Starting 1	ſhreshold:		.nġdć.noặa.go ,equal to				PASS ≤ 0.50 mps
ſ				7.0 		0.43 imps	- Pas	s? / Fail?:	≤ 0.50 mps
	Test	Accura	cy Test Re	7.0 gm-cm		0.43 imps Test	Pas Lineari	s? / Fail?: ty Test Re	<u>≤ 0.50 mps</u>
	Test Input	Accura Output	cy Test Re Error	7.0 gm-cm esponse		0.43 imps Test Input	Pas Lineari Output	s? / Fail?: ty Test Re Nrmlzd*	<u>≤ 0.50 mps</u> sponse Pass?
	Test Input Deg.	Accura Output Deg.	cy Test Re Error Deg.	7.0 gm-cm sponse Pass? Fail?		0.43 mps Test Input Deg.	Pas Lineari Output Deg.	ty Test Re Nrmlzd* Deg.	≤ 0.50 mps sponse Pass? Fail?
	Test Input Deg. 0	Accura Output Deg.	cy Test Re Error Deg. 1	7.0 gm-cm Pass? Fail? PASS		0.43 imps Test Input Deg. 0	Lineari Output Deg.	is? / Fail?: ity Test Re Nrmlzd* Deg. NA	≤ 0.50 mps sponse Pass? Fail? NA
	Test Input Deg. 0 90	Accura Output Deg. 1 91	cy Test Re Error Deg. 1	7.0 gm-cm Pass? Fail? PASS PASS		0.43 mps Test Input Deg. 0 30	Pas Lineari Output Deg. 32	s? / Fail?: ty Test Re Nrmlzd* Deg NA 1	≤ 0.50 mps sponse Pass? Fail? NA PASS
	Test Input Deg. 0 90 180	Accura Output Deg. 1 91 179	cy Test Re Error Deg. 1	7.0 gm-cm Pass? Fail? PASS PASS PASS	,equal to	0.43 imps Test Input Deg. 0	Lineari Output Deg.	is? / Fail?: ity Test Re Nrmlzd* Deg. NA	≤ 0.50 mps sponse Pass? Fail? NA PASS PASS
	Test Input Deg. 0 90	Accura Output Deg. 1 91	cy Test Re Error Deg. 1 1	7.0 gm-cm Pass? Fail? PASS PASS	,equal to	0.43 imps Test Input Deg. 0 30 60	Pas	s? / Fail?: ty Test Re Nrmlzd* Deg. NA 1 -1	≤ 0.50 mps sponse Pass? Fail? NA PASS
COMMENT	Test Input Deg. 0 90 180. 270	Accura Output Deg. 1 91 179	cy Test Re Error Deg. 1 1	7.0 gm-cm Pass? Fail? PASS PASS PASS	,equal to	0.43 imps Test Input Deg. 0 30 60 90	Pas Lineari Output Deg. 32 61 90	ty Test Re Nrmlzd* Deg NA 1 -1	≤ 0.50 mps sponse Pass? Fail? NA PASS PASS PASS
	Test Input Deg. 0 90 180. 270	Accura Output Deg. 1 91 179	cy Test Re Error Deg. 1 1 -1 1	7.0 gm-cm Pass? Fail? PASS PASS PASS PASS	,equal to	0.43 imps Test Input Deg. 0 30 60 90 120	Pas Lineari Output Deg. 32 61 90 120	s? / Fail?: ty Test Re Nrmlzd* Deg. NA 1 -1 -1 0	≤ 0.50 mps sponse Pass? Fail? NA PASS PASS PASS PASS
- The cross north on 8/	Test Input Deg. 0 90 180 270 Sarm was n (23/2010.	Accura Output Deg. 1 91 179 271 neasured a The accura	cy Test Re Error Deg. 1 1 1 1 1 t 272 degre cy test resp	7.0 gm-cm Pass? Fail? PASS PASS PASS PASS PASS	,equal to	0.43 imps Test Input Deg. 0 30 60 90 120 150	Pas Lineari Output Deg. 32 61 90 120 149	s? / Fail?: ty Test Re Nrmlzd* Deg NA 1 -1 -1 0 -1	 ≤ 0.50 mps sponse Pass? Fail? NA PASS PASS PASS PASS PASS PASS
- The cross north on 8/ measured	Test Input Deg. 0 90 180 270 S sarm was n /23/2010. against the	Accura Output Deg. 1 91 179 271 , neasured a The accurate crossarm,	cy Test Re Error Deg. 1 1 1 1 1 t 272 degre cy test resp and theref	7.0 gm-cm Pass? Fail? PASS PASS PASS PASS PASS	,equal to	0.43 imps Test Input Deg. 0 30 60 90 120 150 180	Pas Lineari Output Deg. 32 61 90 120 149 179	s? / Fail?: ty Test Re Nrmlzd* Deg. NA 1 -1 -1 0 -1 0	 ≤ 0.50 mps sponse Pass? Fail? NA PASS PASS PASS PASS PASS PASS PASS PASS
- The cross north on 8/ measured	Test Input Deg. 0 90 180 270 S sarm was n /23/2010. against the	Accura Output Deg. 1 91 179 271 neasured a The accura	cy Test Re Error Deg. 1 1 1 1 1 t 272 degre cy test resp and theref	7.0 gm-cm Pass? Fail? PASS PASS PASS PASS PASS	,equal to	0.43 imps Test Input Deg. 0 30 60 30 60 120 150 180 210	Pas Lineari Output Deg. 32 61 90 120 149 179 209	s? / Fail?: ty Test Re Nrmlzd* Deg. NA 1 -1 -1 0 -1 0 -1 0 1	 ≤ 0.50 mps sponse Pass? Fail? NA PASS
- The cross north on 8/ measured by 2 degre	Test Input Deg. 0 90 180 270 S sarm was n /23/2010. against the	Accura Output Deg. 1 91 179 271 , neasured a The accurate crossarm,	cy Test Re Error Deg. 1 1 1 1 1 t 272 degre cy test resp and theref	7.0 gm-cm Pass? Fail? PASS PASS PASS PASS PASS	,equal to	0.43 imps Test Input Deg. 0 30 60 90 120 150 180 210 240	Pas Lineari Output Deg. 1. 32 61 90 120 149 179 209 239	s? / Fail?: ty Test Re Nrmlzd* Deg. NA 1 -1 0 -1 0 1 -1 0 1 -1	 ≤ 0.50 mps sponse Pass? Fail? NA PASS
- The cross north on 8/ measured by 2 degre	Test Input Deg. 0 90 180 270 S sarm was n /23/2010. against the	Accura Output Deg. 1 91 179 271 , neasured a The accurate crossarm,	cy Test Re Error Deg. 1 1 1 1 1 t 272 degre cy test resp and theref	7.0 gm-cm Pass? Fail? PASS PASS PASS PASS PASS	,equal to	0.43 imps Test Input Deg. 0 30 60 30 60 120 150 150 180 210 240 270	Pas Lineari Output Deg. 32 61 90 120 149 179 209 239 269	s? / Fail?: ty Test Re Nrmlzd* Deg. NA 1 -1 -1 0 -1 -1 0 1 -1 1 1	 ≤ 0.50 mps sponse Pass? Fail? NA PASS
- The cross north on 8/ measured by 2 degre	Test Input Deg. 0 90 180 270 S sarm was n /23/2010. against the	Accura Output Deg. 1 91 179 271 , neasured a The accurate crossarm,	cy Test Re Error Deg. 1 1 1 1 1 t 272 degre cy test resp and theref	7.0 gm-cm Pass? Fail? PASS PASS PASS PASS PASS	,equal to	0.43 imps Test Input Deg. 0 30 60 90 120 150 150 180 210 240 270 300	Pas Lineari Output Deg. 32 61 90 120 149 179 209 239 269 299	s? / Fail?: ty Test Re Nrmlzd* Deg NA 1 -1 -1 0 -1 -1 0 1 -1 1 0	 ≤ 0.50 mps sponse Pass? Fail? NA PASS
- The cross north on 8/ measured by 2 degre	Test Input Deg. 0 90 180 270 S sarm was n /23/2010. against the	Accura Output Deg. 1 91 179 271 , neasured a The accurate crossarm,	cy Test Re Error Deg. 1 1 1 1 1 t 272 degre cy test resp and theref	7.0 gm-cm Pass? Fail? PASS PASS PASS PASS PASS	,equal to	0.43 imps Test Input Deg. 0 30 60 30 90 120 150 150 180 210 240 270 300 330 330	Pas Lineari Output Deg. 32 61 90 120 149 179 209 239 269 299 329	s? / Fail?: ty Test Re Nrmlzd* Deg. NA 1 -1 0 -1 0 1 -1 1 0 0 1 -1 1 0 0 -1 -1 1 0 -1 -1 -1 0 -1 -1 0 -1 -1 -1 0 -1 -1 -1 -1 0 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1	 ≤ 0.50 mps sponse Pass? Fail? NA PASS

			PART A	A. ANC	ILLARY	INFORM	ATION			
Project:	North Butte	е		Date:	07/14/201	1		(Check One	
Location:	Wyoming				11:20 07/1			As Found:	N	
chnician:	Ethan Brow	wn		End:	10:55 12/2	2/2010		As Left:	<u>.</u>	
				SENSO						
Make:	Met Qne						2-Meter	Probe SN:	J10798	(2 of 2)
		• • •	· · · · ·	•					J10798	
	<u> </u>	: .	· · ·	• .					-50 to +50	
			~	LIBRATIC	NH TÉÓT		NT			
		Destaura					<u>.in I</u>		CN-	0501000114
Item: Item:				GmbH P65 with mecha				(SN: SN:	
nem.				With Hieona		ig.		·		
			- 2 N	1	1 - 1 - 1				1	
	Known	Input		Observe	d Data Lo	gger Resp	onse			
	Water	Temp.	2-m	2-m	Pass?	10-m	10-m	Pass?		
	Water Bath	Temp. ℃	2-m ℃	2-m Error ⁰C	Pass? Fail?	10-m ℃ີ	10-m Error °C	Fail?		
	Water Bath Ice	Temp. °C -8.60	2-m °C -8.59	2-m Error °C 0.01	Pass? Fail? PASS	10-m ℃ -8.51	10-m Error °C 0.09	Fail? PASS		
	Water Bath Ice Cool	Temp. °C -8.60 20.44	2-m °C -8.59 20.36	2-m Error °C 0.01 -0.08	Pass? Fail? PASS PASS	10-m °C -8.51 20.37	10-m Error °C 0.09 -0.07	Fail? PASS PASS		÷
	Water Bath Ice	Temp. °C -8.60	2-m °C -8.59	2-m Error °C 0.01	Pass? Fail? PASS	10-m ℃ -8.51	10-m Error °C 0.09	Fail? PASS		:
	Water Bath Ice Cool Hot	Temp. °C -8.60 20.44 38.04	2-m °C -8.59 20.36 38.04	2-m Error °C 0.01 -0.08	Pass? Fail? PASS PASS PASS	10-m °C -8.51 20.37	10-m Error °C 0.09 -0.07	Fail? PASS PASS		:
	Water Bath Ice Cool Hot	Temp. °C -8.60 20.44 38.04	2-m °C -8.59 20.36 38.04	2-m Error °C 0.01 -0.08 0.00	Pass? Fail? PASS PASS PASS	10-m °C -8.51 20.37	10-m Error °C 0.09 -0.07 0.00	Fail? PASS PASS PASS	aths were c	onstantly
	Water Bath Ice Cool Hot Tempera	Temp. °C -8.60 20.44 38.04 hture Diffe	2-m °C -8.59 20.36 38.04 rence Sys Cobse 2-10 ΔT	2-m Error °C 0.01 -0.08 0.00 stem Calit stem Calit crved Resp 2-10 ΔT	Pass? Fail? PASS PASS PASS oration	10-m °C -8.51 20.37	10-m Error °C 0.09 -0.07 0.00 (NOTE: T agitated	Fail? PASS PASS PASS he water ba	anical stirrir	
	Water Bath Ice Cool Hot Tempera Known Water Bath	Temp. °C -8.60 20.44 38.04 hture Diffe	2-m °C -8.59 20.36 38.04 rence System 2-10 ΔT °C	2-m Error °C 0.01 -0.08 0.00 stem Calit stem Calit 2-10 ΔT Error °C	Pass? Fail? PASS PASS PASS oration onse Pass? Fail?	10-m °C -8.51 20.37	10-m Error °C 0.09 -0.07 0.00 (NOTE: T agitated	Fail? PASS PASS PASS	anical stirrir	
	Water Bath Ice Cool Hot Tempera Known Water Bath Ice	Temp. °C -8.60 20.44 38.04 38.04 ture Diffe ΔT °C 0.00	2-m °C -8.59 20.36 38.04 rence Sys 2-10 ΔT °C -0.08	2-m Error °C 0.01 -0.08 0.00 stem Calil stem Calil 2-10 ΔT Error °C -0.08	Pass? Fail? PASS PASS PASS oration onse Pass? Fail? PASS	10-m °C -8.51 20.37	10-m Error °C 0.09 -0.07 0.00 (NOTE: T agitated the calib	Fail? PASS PASS PASS he water ba with mecha ration tests	anical stirrir .)	ng during
	Water Bath Ice Cool Hot Tempera Known Water Bath Ice Cool	Temp. °C -8.60 20.44 38.04 38.04 ture Diffe ΔT °C 0.00 0.00 0.00	2-m °C -8.59 20.36 38.04 rence Sys C 2-10 ΔT °C -0.08 -0.02	2-m Error °C 0.01 -0.08 0.00 stem Calit stem Calit stem Calit f 2-10 ΔT Error °C -0.08 -0.02	Pass? Fail? PASS PASS PASS oration Pass? Fail? PASS PASS	10-m °C -8.51 20.37	10-m Error °C 0.09 -0.07 0.00 (NOTE: T agitated the calib (NOTE: D	Fail? PASS PASS PASS he water ba with mecha ration tests uring the Δ	anical stirrir .) T calibratio	ng during n, both
	Water Bath Ice Cool Hot Tempera Known Water Bath Ice	Temp. °C -8.60 20.44 38.04 38.04 ture Diffe ΔT °C 0.00	2-m °C -8.59 20.36 38.04 rence Sys 2-10 ΔT °C -0.08	2-m Error °C 0.01 -0.08 0.00 stem Calil stem Calil 2-10 ΔT Error °C -0.08	Pass? Fail? PASS PASS PASS oration onse Pass? Fail? PASS	10-m °C -8.51 20.37	10-m Error °C 0.09 -0.07 0.00 (NOTE: T agitated the calib (NOTE: D probes w	Fail? PASS PASS PASS he water ba with mecha ration tests uring the Δ	anical stirrir .)	ng during n, both
	Water Bath Ice Cool Hot Tempera Known Water Bath Ice Cool	Temp. °C -8.60 20.44 38.04 38.04 ture Diffe ΔT °C 0.00 0.00 0.00	2-m °C -8.59 20.36 38.04 rence Sys C 2-10 ΔT °C -0.08 -0.02	2-m Error °C 0.01 -0.08 0.00 stem Calili stem Calili 2-10 ΔT Error °C -0.08 -0.02 0.00	Pass? Fail? PASS PASS PASS PASS Pass? Fail? PASS PASS PASS	10-m °C -8.51 20.37 38.04	10-m Error °C 0.09 -0.07 0.00 (NOTE: T agitated the calib (NOTE: D	Fail? PASS PASS PASS he water ba with mecha ration tests uring the Δ	anical stirrir .) T calibratio	ng during n, both
	Water Bath Ice Cool Hot Tempera Known Water Bath Ice Cool	Temp. °C -8.60 20.44 38.04 38.04 ture Diffe ΔT °C 0.00 0.00 0.00	2-m °C -8.59 20.36 38.04 rence Sys C 2-10 ΔT °C -0.08 -0.02	2-m Error °C 0.01 -0.08 0.00 stem Calili stem Calili 2-10 ΔT Error °C -0.08 -0.02 0.00	Pass? Fail? PASS PASS PASS oration Pass? Fail? PASS PASS	10-m °C -8.51 20.37 38.04	10-m Error °C 0.09 -0.07 0.00 (NOTE: T agitated the calib (NOTE: D probes w	Fail? PASS PASS PASS he water ba with mecha ration tests uring the Δ	anical stirrir .) T calibratio	ng during n, both
	Water Bath Ice Cool Hot Tempera Known Water Bath Ice Cool	Temp. °C -8.60 20.44 38.04 38.04 ture Diffe ΔT °C 0.00 0.00 0.00	2-m °C -8.59 20.36 38.04 rence Sys C 2-10 ΔT °C -0.08 -0.02	2-m Error °C 0.01 -0.08 0.00 stem Calil rerved Resp 2-10 ΔT Error °C -0.08 -0.02 0.00	Pass? Fail? PASS PASS PASS PASS Pass? Fail? PASS PASS PASS	10-m °C -8.51 20.37 38.04	10-m Error °C 0.09 -0.07 0.00 (NOTE: T agitated the calib (NOTE: D probes w	Fail? PASS PASS PASS he water ba with mecha ration tests uring the Δ	anical stirrir .) T calibratio	ng during n, both
	Water Bath Ice Cool Hot Tempera Known Water Bath Ice Cool	Temp. °C -8.60 20.44 38.04 38.04 ture Diffe ΔT °C 0.00 0.00 0.00	2-m °C -8.59 20.36 38.04 rence Sys C 2-10 ΔT °C -0.08 -0.02	2-m Error °C 0.01 -0.08 0.00 stem Calil rerved Resp 2-10 ΔT Error °C -0.08 -0.02 0.00	Pass? Fail? PASS PASS PASS PASS Pass? Fail? PASS PASS PASS	10-m °C -8.51 20.37 38.04	10-m Error °C 0.09 -0.07 0.00 (NOTE: T agitated the calib (NOTE: D probes w	Fail? PASS PASS PASS he water ba with mecha ration tests uring the Δ	anical stirrir .) T calibratio	ng during n, both
Το ΡΑ	Water Bath Ice Cool Hot Tempera Known Water Bath Ice Cool Hot	Temp. °C -8.60 20.44 38.04 ture Diffe Input ΔT °C 0.00 0.00 0.00 0.00	2-m °C -8.59 20.36 38.04 rence Sys C 2-10 ΔT °C -0.08 -0.02 0.00	2-m Error °C 0.01 -0.08 0.00 stem Calil rerved Resp 2-10 ΔT Error °C -0.08 -0.02 0.00	Pass? Fail? PASS PASS PASS oration Pass? Fail? PASS PASS PASS	10-m °C -8.51 20.37 38.04	10-m Error °C 0.09 -0.07 0.00 (NOTE: T agitated the calib (NOTE: D probes w	Fail? PASS PASS PASS he water bar with mechar ration tests uring the Δ ere placed	anical stirrir .) T calibratio	ng during n, both

		PART	A: ANC	ILLARY	NFORM	IATION		
Project: <u>North Bu</u>	tte		Date:	07/14/2011	•		(Check One:
Location: Wyomin	g °		Start:	11:20 07/14	/2011		As Found:	v
Technician: Ethan Br	own		End:	10:55 12/22	2/2010		As Left:	<i>.</i>
			<u>SENSO</u>		IATION			
Make: LiCor		·				Operati	ng Range:	0 to 1,400 W/m ²
Model: 200 Pyra	nometer				He	ight Aboy	e Ground:	1.8 meters
SN: PY57334	1		·	· .	•			
		~						
· .				<u>ON TEST E</u>	QUIPME	<u>N I</u>		
Item: Kipp & Z						<u> </u>	SN:	
Item: Fluke, M	odel 289, dig	ital multime	ter (4.5 dig	jits, True RM	IS)	<u></u>	SN:	96210097
			CALIE	RATION	TECT		<u>د</u>	
	r.		GALID		ILJIT		5 . 1	
	Known	Input	737 - 4 - 4	Observe	d DAS Be	sponse		ן
	Period	Value	ĎĂS	Error	Error	Ērror	Pass?	
	hhmm	W/m ²	W/m ²	Ŵ/m²	%	% F.S.	Fail? ⁴	
	Covered	0.2	0	0	NA	NA	PASS	
. <u>.</u>	-	718.20	726	8	1.1	. 0.6	PASS	1 1
		766	779	13	1.8	1.0	PASS	
		802	819	17	2.1	1.2	PASS	
	,,	824	840	16	1.9	1.1	PÁSS	-
		856	876	20	2.3	1.4	PASS	
		Calibra	ion Curve	Results ⇔	Slope: 1	1.0199	PASS	
					ntercept: ²		PASS	
				Co	rr. Coeff: ³	1.0000	PASS	
								<u> </u>
			C	COMMENT	<u>s</u>			
			_					
- It was difficult to g	et a large ran	ge of value	s due to in	creasing clo	ud cover th	roughout th	ne day.	
			1.01	4.0.05-				
To PASS, t	he sensor m	ust have		1.0 ±0.05 t = ≤ 1% of F	ull Scale			
				ion Coefficie				

	PART	A: ANCILLARY INFORMA	TION
Project: North Bu	itte	Date: 07/14/2011	Check One:
Location: Wyoming	g	Start: 11:20.07/14/2011	As Found: √
echnician: Ethan Br		End: 10:55 12/22/2010	As Left:
		SENSOR INFORMATION	
Make: Vaisala			Operating Range: <u>0-100%</u>
Model: HMP45A		Heigh	nt Above Ground: 2 meters
SN: C192008	36	÷ .	
	<u>C/</u>	LIBRATION TEST EQUIPMENT	
Item: Fisher Se	cientific Traceable Hygro	ometer, Thermometer, Dew Point	SN: 72366727
	PART B:	CALIBRATION TEST RE	SULTS
		OBSERVED RESPONSE	· · · ·
	KNOWN INPUT	DAS Error Pass?	
	Test %RH	%RH %RH Fail?	
	Ambient 38.8	32.95.9 PASS	· · · ·
	Chmbr. 96.5	91.1 -5.4 PASS	
			1
	•	COMMENTS	
Could not get abor	mbor bigbor than 60 % r		compile with a calification partificato
- Could not get char Even though it pass	nber higher than 60 % re	elative humidity. The Vaisala sensor	comes with a calibration certificate.
Even though it pass	nber higher than 60 % r ed this audit, a new cha r Scientific Hygrometer.	elative humidity. The Vaisala sensor mber will need to be used for the 6 m	comes with a calibration certificate. onth calibration. Suggest using salts
Even though it pass	ed this audit, a new cha	elative humidity. The Vaisala sensor mber will need to be used for the 6 m	comes with a calibration certificate. onth calibration. Suggest using salts
Even though it pass	ed this audit, a new cha	elative humidity. The Vaisala sensor mber will need to be used for the 6 m	comes with a calibration certificate. onth calibration. Suggest using salts
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Even though it pass	ed this audit, a new cha	elative humidity. The Vaisala sensor mber will need to be used for the 6 m	comes with a calibration certificate. onth calibration. Suggest using salts
Even though it pass	ed this audit, a new cha	elative humidity. The Vaisala sensor mber will need to be used for the 6 m	comes with a calibration certificate. onth calibration. Suggest using salts
Even though it pass	ed this audit, a new cha	elative humidity. The Vaisala sensor mber will need to be used for the 6 m	comes with a calibration certificate. onth calibration. Suggest using salts
Even though it pass	ed this audit, a new cha	elative humidity. The Vaisala sensor mber will need to be used for the 6 m	comes with a calibration certificate. onth calibration. Suggest using salts
Even though it pass	ed this audit, a new cha	elative humidity. The Vaisala sensor mber will need to be used for the 6 m	comes with a calibration certificate. onth calibration. Suggest using salts
Even though it pass	ed this audit, a new cha	elative humidity. The Vaisala sensor mber will need to be used for the 6 m	çomes with a calibration certificate. onth calibration. Suggest using salts
Even though it pass	ed this audit, a new cha	elative humidity. The Vaisala sensor mber will need to be used for the 6 m	comes with a calibration certificate. onth calibration. Suggest using salts
Even though it pass	ed this audit, a new cha	elative humidity. The Vaisala sensor mber will need to be used for the 6 m	comes with a calibration certificate. onth calibration. Suggest using salts
Even though it pass	ed this audit, a new cha	elative humidity. The Vaisala sensor mber will need to be used for the 6 m	comes with a calibration certificate. onth calibration. Suggest using salts
Even though it pass	ed this audit, a new cha	elative humidity. The Vaisala sensor mber will need to be used for the 6 m	comes with a calibration certificate. onth calibration. Suggest using salts
Even though it pass	ed this audit, a new cha	elative humidity. The Vaisala sensor mber will need to be used for the 6 m	comes with a calibration certificate. onth calibration. Suggest using salts
Even though it pass	ed this audit, a new cha	elative humidity. The Vaisala sensor mber will need to be used for the 6 m	comes with a calibration certificate. onth calibration. Suggest using salts

							EPORT
		PART A	: ANCI	LLARY	INFORM	IATION	
Project: North Butte			Date:	07/14/2011			Check One:
Location: Wyoming			Start:	11:20 07/1	4/2011	. /	As Found:√
Technician: Ethan Brown	n		End:	10:55 12/2	2/2010		As Left:
			<u>SENSO</u>		<u>IATION</u>		
Make: Met One							uge Type: Tipping Bucket
Model: <u>TR525USW</u> SN: 45508-1010					н		ng Range: <u>NA</u> e Ground: 76.20 cm
3N . 43308-1010					1 34		
		<u>CA</u>	LIBRATIC	<u>ON TEST I</u>		<u>NT</u>	
Item: Distilled wat	ter, graduat	ed cylinde	rs, drip dev	ice			SN : <u>NA</u>
	P	ART B:	CALIB	RATION	TEST F	RESULT	S
]	[OBSERVE	D RESPO	NSE]
Ē	KNOWN	INPUT	DAS	Error	Error	Pass?	
	ml, H₂O	mm	mm	mm	%	Fail? ¹	
	250	7.60	7.11	-0.49	-6.4	PASS	
				· · · ·			
			<u>C</u>	OMMENT	<u>'S</u>		

			SPEED	SENS	OR CA	LIBRAT		EPORT	
			PART A	: ANC	ILLARY	INFORM	NATION		
Project:	North Butte	9		Date:	1/11/2012			с	heck One:
Location:	Wyoming			Start:	11:00 1/11	/2012		As Found:	√
Fechnician:	Will Kaage			End:	15:00 1/11	/2012		As Left: _	
				SENSO					
Make:	RM Young			<u>021100</u>			Pro	peller SN:	
-		ind Monitor - /	AQ					-	0 to 50 mps
•	WM106261					He	-	e Ground:	
-		·						-	
			<u>CA</u>	LIBRATIC	<u>ON TEST</u>	EQUIPME	NŢ		
•		otor. R.M.You						· –	CA03277
•		otor. R.M.You			0 to 300 rp	n)		· –	CA03277
Item:	Torque dis	k device. R.N	I.Young, 18	312					NA
ſ	Known	Input	<u> </u>	Observ	ed Data Lo	ogger Resp	onse]	
	Known Motor	Motor	Output	Error	Error	Limit	Limit	Pass?	
	rpm	mph	mph	mps	%	mps	%	Fail?	
	المحمد والمحاد		0.00	0.00	NA	NA	NA	NA	
L	0.0	0.00							
	0.0 200	0.00 2.29	2.29	0.00	0.0	≤ ±0.20		PASS	
					· · · · · ·	≤ ±0.20 	 ≤ ±5%	PASS PASS	
	200	2.29	2.29	0.00	0.0				
	200 500 800 1,000	2.29 5.73 9.16 11.45	2.29 5.73 9.16 11.45	0.00 0.00 0.00 0.00	0.0 0.0 0.0 0.0		≤ ±5% ≤ ±5% ≤ ±5%	PASS PASS PASS	
	200 500 800 1,000 3,000	2.29 5.73 9.16 11.45 34.35	2.29 5.73 9.16 11.45 34.35	0.00 0.00 0.00 0.00 0.00	0.0 0.0 0.0 0.0 0.0		$\leq \pm 5\%$ $\leq \pm 5\%$ $\leq \pm 5\%$ $\leq \pm 5\%$	PASS PASS PASS PASS	
	200 500 800 1,000	2.29 5.73 9.16 11.45	2.29 5.73 9.16 11.45	0.00 0.00 0.00 0.00	0.0 0.0 0.0 0.0		≤ ±5% ≤ ±5% ≤ ±5%	PASS PASS PASS	<u></u>
	200 500 800 1,000 3,000	2.29 5.73 9.16 11.45 34.35	2.29 5.73 9.16 11.45 34.35	0.00 0.00 0.00 0.00 0.00 0.00	0.0 0.0 0.0 0.0 0.0	 	$\leq \pm 5\%$ $\leq \pm 5\%$ $\leq \pm 5\%$ $\leq \pm 5\%$	PASS PASS PASS PASS	
	200 500 800 1,000 3,000	2.29 5.73 9.16 11.45 34.35	2.29 5.73 9.16 11.45 34.35	0.00 0.00 0.00 0.00 0.00 0.00	0.0 0.0 0.0 0.0 0.0 0.0	 	$\leq \pm 5\%$ $\leq \pm 5\%$ $\leq \pm 5\%$ $\leq \pm 5\%$	PASS PASS PASS PASS	
	200 500 800 1,000 3,000	2.29 5.73 9.16 11.45 34.35	2.29 5.73 9.16 11.45 34.35	0.00 0.00 0.00 0.00 0.00 0.00	0.0 0.0 0.0 0.0 0.0 0.0	 	$\leq \pm 5\%$ $\leq \pm 5\%$ $\leq \pm 5\%$ $\leq \pm 5\%$	PASS PASS PASS PASS	
	200 500 800 1,000 3,000	2.29 5.73 9.16 11.45 34.35	2.29 5.73 9.16 11.45 34.35	0.00 0.00 0.00 0.00 0.00 0.00	0.0 0.0 0.0 0.0 0.0 0.0	 	$\leq \pm 5\%$ $\leq \pm 5\%$ $\leq \pm 5\%$ $\leq \pm 5\%$	PASS PASS PASS PASS	
	200 500 800 1,000 3,000	2.29 5.73 9.16 11.45 34.35	2.29 5.73 9.16 11.45 34.35	0.00 0.00 0.00 0.00 0.00 0.00	0.0 0.0 0.0 0.0 0.0 0.0	 	$\leq \pm 5\%$ $\leq \pm 5\%$ $\leq \pm 5\%$ $\leq \pm 5\%$	PASS PASS PASS PASS	
	200 500 800 1,000 3,000	2.29 5.73 9.16 11.45 34.35	2.29 5.73 9.16 11.45 34.35	0.00 0.00 0.00 0.00 0.00 0.00	0.0 0.0 0.0 0.0 0.0 0.0	 	$\leq \pm 5\%$ $\leq \pm 5\%$ $\leq \pm 5\%$ $\leq \pm 5\%$	PASS PASS PASS PASS	
	200 500 800 1,000 3,000	2.29 5.73 9.16 11.45 34.35	2.29 5.73 9.16 11.45 34.35	0.00 0.00 0.00 0.00 0.00 0.00	0.0 0.0 0.0 0.0 0.0 0.0	 	$\leq \pm 5\%$ $\leq \pm 5\%$ $\leq \pm 5\%$ $\leq \pm 5\%$	PASS PASS PASS PASS	<u> </u>
	200 500 800 1,000 3,000	2.29 5.73 9.16 11.45 34.35	2.29 5.73 9.16 11.45 34.35	0.00 0.00 0.00 0.00 0.00 0.00	0.0 0.0 0.0 0.0 0.0 0.0	 	$\leq \pm 5\%$ $\leq \pm 5\%$ $\leq \pm 5\%$ $\leq \pm 5\%$	PASS PASS PASS PASS	
	200 500 800 1,000 3,000 8,000	2.29 5.73 9.16 11.45 34.35	2.29 5.73 9.16 11.45 34.35 91.60	0.00 0.00 0.00 0.00 0.00 0.00	0.0 0.0 0.0 0.0 0.0 0.0 COMMEN	 <u></u> <u></u> <u></u> <u></u> <u></u>	 ≤ ±5% ≤ ±5% ≤ ±5% ≤ ±5% 	PASS PASS PASS PASS	<u>.</u>

			PART A	: ANC	ILLARY	INFORI	MATION		
Project:	North Butte	ə		Date:	1/11/2012	1	_	c	Check One:
Location:				Start:	11:00 1/11	/2012	-	As Found:	
echnician:	Will Kaage	-)		End:	15:00 1/11	/2012	-		<u> </u>
				<u>SENSC</u>	R INFORM	MATION			
Make:	RM Young		int.				Pro	peller SN:	
	· · ·	ind Monitor	- AQ				•	•	0 to 50 mps
SN:	WM10626	1	<u> </u>			Н	eight Abov	e Ground:	10 meters
			C A			EOUIDME	:NT		
					ONTEST				
		ocket transit	-			·····		• • •	50806100
		g, Model 183	· · ·						NA
Item:	R.M.Young	g, Model 181	112, - vane	angle fixtu	re	5 P + +	1 2 2 7 2	SN:	NA
		lagnetic De r Starting T	۰ ۱۹۹۰ - ۲۰۰۹ ۱۹۹۰ - ۲۰۰۹ - ۲۰۰۹	.(http://www 5.0	.ngdc.noaa.g ,equal to	0.37	· • • • •	iation.jsp)	PASS
		~	۰ ۱۹۹۰ - ۲۰۰۹ ۱۹۹۰ - ۲۰۰۹ - ۲۰۰۹	(http://www	.ngdc.noaa.g		· • • • •	· · · · ·	the states of the second se
ſ		r Starting T	۰ ۱۹۹۰ - ۲۰۰۹ ۱۹۹۰ - ۲۰۰۹ - ۲۰۰۹	.(http://www 5.0 gm-cm	.ngdc.noaa.g ,equal to	0.37	_ Pas	· · · · ·	PASS ≤ 0.50 mps
	Sensor Test Input	r Starting T Accurac Output	hreshold: cy Test Re Error	(http://www 5.0 gm-cm sponse Pass?	.ngdc.noaa.g ,equal to	0.37 mps Test Input	Pas Lineari Output	s? / Fail?: ty Test Re	PASS ≤ 0.50 mps sponse Pass?
	Sensor Test Input Deg.	Accurate Output	hreshold: cy Test Re Error Deg.	(http://www 5.0 gm-cm sponse Pass? Fail?	.ngdc.ňoạa.g ,equal to	0.37 mps Test Input Deg.	Pas Lineari Output .Deg.	s? / Fail?: ty Test Re Nrmlzd* Deg.	PASS ≤ 0.50 mps sponse Pass? Fail?
	Sensor Test Input Deg. 0	Accurate Output Deg. 0	hreshold: cy Test Re Error Deg. 0	(http://www 5.0 gm-cm Pass? Fail? PASS	.ngdc.noaa.g ,equal to	0.37 mps Test Input Deg.	Pas Lineari Output .Deg.	ty Test Real Nrmlzd* Deg.	PASS ≤ 0.50 mps sponse Pass? Fail?
	Sensor Test Input Deg. 0 91	Accurate Output Deg. 0 89	hreshold: cy Test Re Error Deg. 0 -2	(http://www 5.0 gm-cm Pass? Fail? PASS PASS	.ngdc.ňoạa.g ,equal to	0.37 mps <u>Test</u> Input Deg.	Pas Lineari Output Deg. 29	ty Test Re Nrmlzd* Deg. -1	PASS ≤ 0.50 mps sponse Pass? Fail? NA PASS
	Sensor Test Input Deg. 0 91 	Accurate Output Deg 0 89 181	hreshold: cy Test Re Error Deg. 0 -2 -1	(http://www 5.0 gm-cm Pass? Fail? PASS PASS PASS	.ngdc.ňoạa.g ,equal to	0.37 mps Test Input Deg. 	Pas Lineari Output .Deg. 29 61	s? / Fail?: ty Test Ret Nrmlzd* Deg. NA -1 1	PASS ≤ 0.50 mps sponse Pass? Fail? NA PASS PASS
	Sensor Test Input Deg. 0 91	Accurate Output Deg. 0 89	hreshold: cy Test Re Error Deg. 0 -2 -1 0	(http://www 5.0 gm-cm Pass? Fail? PASS PASS	.ngdc.ñoaa.g	0.37 mps Test Input Deg. ., 0 30 60 90	Pas Lineari Output Deg. 29 61 89	ty Test Re Nrmlzd* Deg. -1	PASS ≤ 0.50 mps sponse Pass? Fail? NA PASS PASS PASS
	Sensor Test Input Deg. 0 91 181 271	Accurate Output Deg. 0 89 181 271	hreshold: cy Test Re Error Deg. 0 -2 -1 0	(http://www 5.0 gm-cm Pass? Fail? PASS PASS PASS	.ngdc.ñoạa.g	0.37 mps Test Input Deg. 	Pas Lineari Output .Deg. 29 61	s? / Fail?: ty Test Re: Deg. NA -1 1 -2 1	PASS ≤ 0.50 mps sponse Pass? Fail? NA PASS PASS
COMMENT	Sensor Test Input Deg. 0 91 181 271	Accurate Output Deg. 0 89 181 271	hreshold: cy Test Re Error Deg. 0 -2 -1 0	(http://www 5.0 gm-cm Pass? Fail? PASS PASS PASS	.ngdc.ñoaa.g	0.37 mps Test Input Deg. 60 90 120	Pas Lineari Output .Deg. 29 61 89 119	s? / Fail?: ty Test Re: Deg. NA -1 1 -2	PASS ≤ 0.50 mps sponse Pass? Fail? NA PASS PASS PASS PASS
COMMENT	Sensor Test Input Deg. 0 91 181 271 S was measu	Accurate Output Deg. 0 89 181 271	hreshold: cy Test Re Error Deg. 0 -2 -1 0	(http://www 5.0 gm-cm Pass? Fail? PASS PASS PASS PASS	.ngdc.ñoaa.g	0.37 mps Input Deg. 0 30 60 90 120 150	Pas Lineari Output Deg. 29 61 89 119 149	s? / Fail?: ty Test Re: Deg. NA -1 1 -2 1 -1	PASS ≤ 0.50 mps sponse Pass? Fail? NA PASS PASS PASS PASS
COMMENT	Sensor Test Input Deg. 0 91 181 271 S S was measu	Accurat Output Deg. 0 89 181 271	hreshold: cy Test Re Error Deg. 0 -2 -1 0 degrees. T sured again	(http://www 5.0 gm-cm Pass? Fail? PASS PASS PASS PASS	.ngdc.ñoaa.g	0.37 mps Test Input Deg. 60 90 120 150 180	Pas Lineari Output .Deg. 29 61 89 119 149 178	s? / Fail?: ty Test Re: Deg. NA -1 1 -2 1 -1 -1	PASS ≤ 0.50 mps sponse Pass? Fail? NA PASS PASS PASS PASS PASS PASS
Crossarm accuracy to crossarm,	Sensor Test Input Deg. 0 91 181 271 S was measu est respons and therefor	Accurate Output Deg. 0 89 181 271	hreshold: cy Test Re Error Deg. 0 -2 -1 0 degrees. T sured again 1 degrees.	(http://www 5.0 gm-cm Pass? Fail? PASS PASS PASS PASS	.ngdc.ñoaa.g	0.37 mps Test Input Deg. 10 60 90 120 150 180 210	Pas Lineari Output Deg. 29 61 89 119 149 178 208	s? / Fail?: ty Test Re: Deg. NA -1 1 -2 1 -1 -1 0	PASS ≤ 0.50 mps sponse Pass? Fail? NA PASS PASS PASS PASS PASS PASS PASS P
Crossarm accuracy to crossarm,	Sensor Test Input Deg. 0 91 181 271 S was measu est respons and therefor	Accurate Output Deg. 0 89 181 271 ured at 271 of se was measore is off by	hreshold: cy Test Re Error Deg. 0 -2 -1 0 degrees. T sured again 1 degrees.	(http://www 5.0 gm-cm Pass? Fail? PASS PASS PASS PASS	.ngdc.ňoạa.g	0.37 mps Test Input Deg. 	Pas Lineari Output .Deg. 29 61 89 119 149 178 208 237	s? / Fail?: ty Test Re: Deg. NA -1 1 -2 1 -1 -1 0 -1	PASS ≤ 0.50 mps sponse Pass? Fail? PASS PASS PASS PASS PASS PASS PASS PAS
Crossarm accuracy to crossarm,	Sensor Test Input Deg. 0 91 181 271 S was measu est respons and therefor	Accurate Output Deg. 0 89 181 271 ured at 271 of se was measore is off by	hreshold: cy Test Re Error Deg. 0 -2 -1 0 degrees. T sured again 1 degrees.	(http://www 5.0 gm-cm Pass? Fail? PASS PASS PASS PASS	.ngdc.ňoạa.g	0.37 mps Test Input Deg. 	Pas Lineari Output Deg. 0 29 61 89 119 149 178 208 237 269 299 331	s? / Fail?: ty Test Ree Nrmlzd* Deg. NA -1 1 -2 1 -1 0 -1 2	PASS ≤ 0.50 mps sponse Pass? Fail? NA PASS PASS PASS PASS PASS PASS PASS P
Crossarm accuracy to crossarm,	Sensor Test Input Deg. 0 91 181 271 S was measu est respons and therefor	Accurate Output Deg. 0 89 181 271 ured at 271 of se was measore is off by	hreshold: cy Test Re Error Deg. 0 -2 -1 0 degrees. T sured again 1 degrees.	(http://www 5.0 gm-cm Pass? Fail? PASS PASS PASS PASS	.ngdc.ňoạa.g	0.37 mps Test Input Deg. 0 30 60 90 120 150 180 210 240 210 240 270 300 330 350	Pas Lineari Output Deg. 29 61 89 119 149 178 208 237 269 299 331 349	s? / Fail?: ty Test Re: Deg. NA -1 1 -2 1 -1 -2 1 -1 0 -1 2 0 2 1	PASS ≤ 0.50 mps sponse Pass? Fail? PASS PASS PASS PASS PASS PASS PASS PAS
Crossarm accuracy to crossarm,	Sensor Test Input Deg. 0 91 181 271 S was measu est respons and therefor	Accurate Output Deg. 0 89 181 271 ured at 271 of se was measore is off by	hreshold: cy Test Re Error Deg. 0 -2 -1 0 degrees. T sured again 1 degrees.	(http://www 5.0 gm-cm Pass? Fail? PASS PASS PASS PASS	.ngdc.ňoạa.g	0.37 mps Test Input Deg. 0 30 60 90 120 150 180 210 240 210 240 270 300 330 350	Pas Lineari Output Deg. 29 61 89 119 149 178 208 237 269 299 331 349 alized error in	s? / Fail?: ty Test Re: Deg. NA -1 1 -2 1 -1 -2 1 -1 0 -1 2 0 2 1	PASS ≤ 0.50 mps sponse Pass? Fail? NA PASS PASS PASS PASS PASS PASS PASS P

			PART A	A: ANC	ILLARY	INFORM	MATION			
Project:	North Butte	Э		Date:	1/11/2012	•		C	Check One:	
	Wyoming				11:00 1/11			As Found:	<u> </u>	24
echnician:	Will Kaage	,		End:	15:00 1/11	/2012	-	As Left:		
				SENSO	R INFORI	MATION				
Make:	Met One	· · · ·	. .	<u></u>			2-Meter	Probe SN:	J10798 (2 of 2).
	062 MP			•					J10798 (1 of 2	· · · · · · · · · · · · · · · · · · ·
		•							-50 to +50 C	
			CA		ON TEST	FOUIPME	NT			
Item:	Item:	Dostmann					<u></u> .		SN: () 6501	0081147
Item:		Insulated v				na.	lat strange			
• •		· -·· P	ART B:	CALIB	RATION	I TEST F	RESULT	s	· · ·	· . ·
	Tompora	ture Prob	o Calibrai	lion	•	1. 1. 1. 1.	- 1 -			
	Tempera		e Calibra				ster en	۰. ۱	st out	
	Known	Input		Observe	d Data Lo	gger Resp	onse			
	Water	Temp.	् 2- m	2-m	Pass?	10-m	,10-m	Pașș?		
	Bath	<u>°C</u>	<u>°C</u>	Error °C	Fail?	<u>°C</u>	Error °C	Fail?	ļ	
	lce .	1.71	1.69	-0.02	PASS	1.75	0.04	PASS		
	Cool	27.99	27.76	-0.23	PASS	27.83	-0.16	PASS		
		the fact			-	1		· · · · · · · · · · · · · · · · · · ·		
	Hot	48.56	48.46	-0.10	PASS	48.52	-0.04	PASS	•	
	Subzero	-12.04	-12.26	-0.22	PASS	48.52 -12.26	-0.04	· · · · · · · · · · · · · · · · · · ·	• •	
	Subzero Tempera		-12.26	-0.22	PASS			PASS	• • • • •	
	Subzero	-12.04 ture Diffe	-12.26 rence Sys	-0.22	PASS pration		-0.22	PASS	aths were constant	у
	Subzero Tempera	-12.04 ture Diffe	-12.26 rence Sγs Οbse 2-10 ΔT	-0.22 stem Calil	PASS pration		-0.22 (NOTE: T	PASS PASS he water ba	aths were constantl	-
	Subzero Tempera	-12.04 ture Diffe Input	-12.26 rence Sys	-0.22 stem Calit erved Resp	PASS		(NOTE: T agitated	PASS PASS he water ba	anical stirring during	-
	Subzero Tempera Known Water	-12.04 ture Diffe Input ΔT	-12.26 rence Sγs Οbse 2-10 ΔT	-0:22 stem Calit erved Resp 2-10 ΔT	PASS		(NOTE: T agitated	PASS PASS he water ba	anical stirring during	-
	Subzero Tempera Known Water Bath Ice Cool	-12.04 ture Diffe Input ΔT °C 0.00 0.00	-12.26 rence Sys 2-10 ΔT °C -0.06 -0.07	-0.22 stem Calif erved Resp 2-10 ΔT Error °C -0.06 -0.07	PASS pration Pass? Fail? PASS PASS		(NOTE: T agitated the calib (NOTE: D	PASS PASS he water ba with mecha ration tests uring the Δ	anical stirring during .) T calibration, both)
	Subzero Tempera Known Water Bath Ice	-12.04 ture Diffe Input ΔT °C 0.00	-12.26 rence Sys Οbse 2-10.ΔT °C -0.06	-0.22 stem Calif erved Resp 2-10 ΔT Error °C -0.06	PASS pration Soonse Pass? Fail? PASS		(NOTE: T agitated the calib (NOTE: D probes w	PASS PASS he water ba with mecha ration tests uring the Δ	anical stirring during .))
	Subzero Tempera Known Water Bath Ice Cool	-12.04 ture Diffe Input ΔT °C 0.00 0.00	-12.26 rence Sys 2-10 ΔT °C -0.06 -0.07	-0.22 stem Calil erved Resp 2-10 ΔT Error °C -0.06 -0.07 -0.06	PASS pration Pass? Fail? PASS PASS PASS	-12.26	(NOTE: T agitated the calib (NOTE: D probes w bath.)	PASS PASS he water ba with mecha ration tests uring the Δ	anical stirring during .) T calibration, both together in the san)
	Subzero Tempera Known Water Bath Ice Cool	-12.04 ture Diffe Input ΔT °C 0.00 0.00	-12.26 rence Sys 2-10 ΔT °C -0.06 -0.07	-0.22 stem Calil erved Resp 2-10 ΔT Error °C -0.06 -0.07 -0.06	PASS pration Pass? Fail? PASS PASS	-12.26	(NOTE: T agitated the calib (NOTE: D probes w	PASS PASS he water ba with mecha ration tests uring the Δ	anical stirring during .) T calibration, both together in the san)
	Subzero Tempera Known Water Bath Ice Cool	-12.04 ture Diffe Input ΔT °C 0.00 0.00	-12.26 rence Sys 2-10 ΔT °C -0.06 -0.07	-0.22 stem Calil erved Resp 2-10 ΔT Error °C -0.06 -0.07 -0.06	PASS pration Pass? Fail? PASS PASS PASS	-12.26	(NOTE: T agitated the calib (NOTE: D probes w bath.)	PASS PASS he water ba with mecha ration tests uring the Δ	anical stirring during .) T calibration, both together in the san)
	Subzero Tempera Known Water Bath Ice Cool	-12.04 ture Diffe Input ΔT °C 0.00 0.00	-12.26 rence Sys 2-10 ΔT °C -0.06 -0.07	-0.22 stem Calil erved Resp 2-10 ΔT Error °C -0.06 -0.07 -0.06	PASS pration Pass? Fail? PASS PASS PASS	-12.26	(NOTE: T agitated the calib (NOTE: D probes w bath.)	PASS PASS he water ba with mecha ration tests uring the Δ	anical stirring during .) T calibration, both together in the san)
	Subzero Tempera Known Water Bath Ice Cool	-12.04 ture Diffe Input ΔT °C 0.00 0.00 0.00	-12.26 rence Sys 2-10 ΔT °C -0.06 -0.07 -0.06	-0.22 stem Calif erved Resp 2-10 ΔT Error °C -0.06 -0.07 -0.06 <u>C</u>	PASS pration Pass? Fail? PASS PASS PASS	<u>-12.26</u>	(NOTE: T agitated the calib (NOTE: D probes w bath.)	PASS PASS he water ba with mecha ration tests uring the Δ ere placed	anical stirring during .) T calibration, both together in the san)

		PART /	: ANC	ILLARY	INFORM	NATION		
Project: North B	Sutte		Date:	1/11/2012 -	÷		с	heck One:
Location: Wyomi				11:00 1/11/			As Found:	
echnician: Will Ka				15:00 1/11/		As Left:		**************************************
Make: LiCor.			<u>SENSO</u>	<u>R INFORM</u>		• •		0 to 1,400 W/m
Model: 200 Py					H	eight Abov	e Ground: _	1.8 meters
SN: PY5733	34	· · · · ·	· · · · ·					
		CA		ON TEST E		NT		. ,
· · · · ·	7 0110	••					-	. · · · ·
	Zonen CM-3 p Model 289, dig					n en Les de recto		<u>58211</u> 96210097
	Known	Input	· · · · ·	Observe	ed DAS Re			
				1				
	Period hhmm	Value W/m²	DAS Ŵ/m²	Error W/m ²	Error %	Error % F.S.	Pass? Fail? ⁴	
	Covered	0.2	0	0	NA	NA	PASS	
, ···	. 11:40	424.33	422	-2	-0.5		PASS 📰	
	12:08	472	485	12	2.6	0.9	PASS	
	12:40	424	429	5	1.2	0.4	PASS	
	13:23	383	396	12	3.2	0.9	PASS	
	14:39	293	301	8	2.7	0.6	PASS	
	14:42	314	307	-7	-2.1	-0.5	PASS	
		Calibrat	tion Curve	Results ⇔	Slope: ¹	1.0163	PASS	
					Intercept: ²		PASS	
				Co	orr. Coeff: ³	0.9991	PASS	
					· C		·····	
			<u>c</u>	COMMENT	3			
- It was difficult to	oet a large ran	ide of value	es due to in	creasing clo	ud cover th	nrouahout t	he dav.	
	got a large ran						···	
			16.		_			
	the sensor m	ust have	Slope =	1.0 ±0.05				
To PASS,	the sensor m	aot navon.	•	t = ≤ 1% of f				

	PART	A: ANCILLARY INFORM	MATION	
Project: North B	utte	Date: 1/11/2012	Ch	eck One:
.ocation: Wyomir	ig	Start: 11:00 1/11/2012	As Found:	<u></u>
chnician: Will Kaa	ige .	End: 15:00 1/11/2012	As Left:	· · ·
		SENSOR INFORMATION		1.000/
Make: Vaisala Model: HMP45/		- -	Operating Range: <u>0</u> eight Above Ground: 2	
SN: C19200	· · · · · · · · · · · · · · · · · · ·	-		
	<u>C</u>	ALIBRATION TEST EQUIPME	<u>NT</u>	
Item: Fisher S	Scientific Traceable Hygro	ometer, Thermometer, Dew Point	SN:	72366727
	PART B:	CALIBRATION TEST P	RESULTS	
		and and a second se Second second s		· • • • •
		OBSERVED RESPONSE		
	KNOWN INPUT	DAS Error Pass?		
	Test %RH	%RH %RH Fail? ¹		
	Ambient 50.5	48.52.0 PASS		
	Chmbr. 84.1	80.9 -3.2 PASS]	
	· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·		
		COMMENTS	 	
			ſ	
Difficult reaching :	100% saturation Venues	old temperatures would start to fre	eze the water before the	sensors would
Dimounteaching				
steady.	, oo ,o catalan, on tory of			
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Prepared 8/5/2010

PAF	RT A: ANCILLARY INFO	RMATION
Project: North Butte	Date: 1/11/2012	Check One:
Location: Wyoming	Start: 11:00 1/11/2012	As Found:√
Fechnician: Will Kaage	End: 15:00 1/11/2012	As Left:
	SENSOR INFORMATIO	N
Make: Met One		Gauge Type: Tipping Bucket
Model: TR525USW		Operating Range: NA
SN : 45508-1010		Height Above Ground: 76.20 cm
	CALIBRATION TEST EQUIP	MENT
Item: Distilled water, graduated c	ylinders, drip device	SN: <u>NA</u>
DAD	B: CALIBRATION TES	
r Ani		
	OBSERVED RES	
ml, H ₂ O m		Fail? ¹
250 7.	60 7.36 -0.24 -3.2	PASS
	O O UNICAITO	
	COMMENTS	

Appendix D

Gas Hills Remote Satellite Meteorological Analysis (Revised November 2014) Gas Hills Remote Satellite Uranium Project Meteorology Analysis

> Cameco Resources Casper, Wyoming

> > May 2012



IML Air Science a division of Inter-Mountain Laboratories, Inc. 555 Absaraka Sheridan, WY 82801 (307) 674-7506

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Appendices

Appendix A – Gas Hills Meteorological Station Calibration Records

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a subtract of the local of the **Introduction** is the second determined of the second determined The Gas Hills Remote Satellite in central Wyoming is located in a semi-arid or we steppe climate. The area is characterized by abundant sunshine, low relative humidity, and sustained winds which lead to high evaporative demand. The region is characterized seasonally by cold winters, warm dry summers, and cool springs and autumns. Temperature extremes range from roughly -30° F in the winter to 100° F in the summer. There are also large diurnal variations in temperature. The "last freeze" occurs during early to mid June and the "first freeze" in early September due to the high elevation.

Yearly precipitation typically averages from 8 to 12 inches. The Gas Hills District is prone to severe thunderstorm events throughout the spring and early summer months. Spring snowstorms and spring/summer thunderstorm events account for the majority of the precipitation during this time period. In a typical year, the region will see 3 or 4 severe thunderstorm events (as defined by the National Weather Service criteria) and 30 to 40 thunderstorm days. Snow falls in the region throughout late fall, winter and early spring months, totaling around 70 inches per year but varying widely with location and elevation. Snowfall contributes substantially to the annual precipitation totals. 1717-1

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Windy conditions are fairly common to the region. Average annual wind speeds range from 8 mph at lower elevations to 14 mph at higher elevations such as the Gas Hills Remote Satellite area. Higher average wind speeds occur during the fall and winter months at higher elevations, while less seasonal variation is observed in the lowlands. The predominant wind direction is generally from the southwest, with stronger westerly and northwesterly components at Riverton and stronger southerly components in the Gas Hills Remote Satellite area. C. D. C. M. A. A. S. 1.1 21.33

For the regional analysis, meteorological data were compiled for five sites surrounding the Gas Hills Remote Satellite area. Hourly average data were acquired from the National Weather Service (NWS) Casper and Riverton airport (AP) sites, through the National Climate Data Center (NCDC, 2012). Data from the South Pass site were acquired from the Wyoming Department of Environmental Quality (WDEQ), and historical data from the Gas Hills 4E site were acquired from the Water Resources Data System (WRDS) managed by the University of Wyoming. Pan evaporation data from the Pathfinder Dam were obtained from the Western Region Climate Center (WRCC). Among these regional sites, the Riverton AP site is the closest NWS weather station to the Gas Hills Remote Satellite (48 miles away). Riverton is also the closest station with available hourly wind data.

For the site-specific analysis, meteorological data from Cameco's Gas Hills Remote Satellite meteorological station were used. These data were collected during an approximately one-year baseline monitoring period extending from

December 8, 2010 through January 27, 2012. Meteorological data from the Gas Hills site include wind speed, wind direction, temperature at 2 meters height, relative humidity, precipitation, solar radiation, and temperature at 10 meters height. Table 2.5-1 lists the regional and on-site meteorological stations used for this analysis, along with coordinates, elevation, and period of record.

	· · · · · ·	· · · ·			
Name	Agency	Long	Lat	Z (ft)	Years of Data
Casper	NWS	-106° 28'	42° 54'	5331	2004 - 2011
Riverton	NWS	- 108° 27'	43° 4'	5417	1996 - 2012
South Pass	WDEQ	-108° 43'	42° 32'	8287	2007 - 2011
Gas Hills 4E	WRDC	-107° 31'	42° 50'	6470	1970 - 1989
Pathfinder Dam	WRDC	-107°,31'	42° 50'	6470	1948 - 1991
Gas Hills On-Sité	Cameco	-107° 31'	42° 50'	6840	2010 - 2012
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Table 2.5-1. Meteorological Stations Included in Climate Analysis.

The state of the second sec These sites have been analyzed collectively to provide a regional range of monthly average temperatures, wind speeds and directions, precipitation, relative humidity, evaporation and snowfall. The Casper, Riverton, South Pass and Pathfinder Dam sites form a guadrilateral with the Gas Hills site roughly in the center Figure 2.5-1 shows the locations of these sites, along with the Gas Hills license/permit boundary. The location of the Gas Hills 4E historical meteorological site, which was removed in 1989 and provided temperature and precipitation data only, is a short distance from the Cameco Gas Hills on-site station. The Pathfinder Dam site provided only evaporation data. On-site evapotranspiration rates were calculated for the Gas Hills project site by applying Penman's equation to available solar radiation, wind speed, temperature and relative humidity data. 9 C. . dia 👔 🔥 👘 ; ;

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Regional and Site Specific Meteorological Characterization

In the information that follows, a regional overview is presented first. This section includes a discussion of the maximum and minimum temperature and relative humidity, annual precipitation including snowfall estimates, and a brief wind speed and direction summary. A combination of monitoring stations is analyzed for the regional overview of temperature, showfall and total precipitation.

A site specific analysis follows the regional overview. Most of this analysis is based on the on-site monitoring. An in-depth wind analysis summarizes average wind speeds and directions, wind roses, wind speed frequency distributions, and a joint (wind speed and direction) frequency distribution to characterize the wind data for the Gas Hills site by atmospheric stability class. The method of stability

class determination is described and illustrated. A discussion of monthly and seasonal data is included for the temperature, precipitation, evapotranspiration and wind parameters. General upper atmosphere data from the National Weather Service station at Lander, Wyoming are used to represent mixing heights at the project site.

The site specific analysis includes a justification for using wind data from the baseline monitoring year to predict meteorological conditions over the long term. This is necessary to validate air sampling locations and MILDOS dispersion modeling inputs. The short and long term wind data from the Riverton AP site are correlated for this purpose. This procedure is repeated for the Casper AP site, yielding similar results.

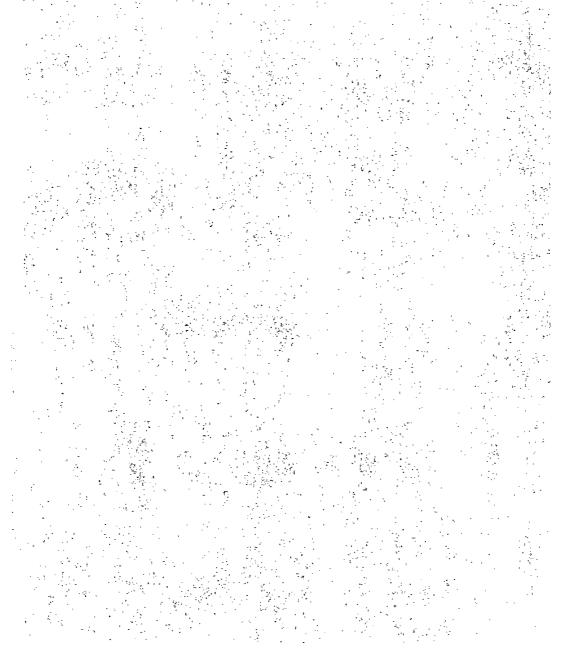




Figure 2.5-1. Regional Meteorological Stations

Regional Overview

Temperature

The annual average temperature for the region containing the Gas Hills ranges from 37.8° F at South Pass (elevation 8,287 ft) to 44.7° at Riverton (elevation 5,417 ft). The Gas Hills 4E meteorological station (elevation 6,470 ft) recorded a 20-year average temperature of 42.6°, slightly less than the Riverton average.

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Figure 2.5-2 shows monthly average temperatures for the Riverton (AP) site, monthly average daily highs and lows, and the monthly maximum and minimum temperatures over the last 15 years. July typically has the highest average monthly temperature (73.5° F), followed by August. December typically records the lowest average temperatures for the year (19.7° F), followed by January. Table 2.5-2 shows monthly temperature statistics for the Riverton AP site. Low temperatures in the region can drop to nearly -30° F, while high temperatures can be as high as 102° F.

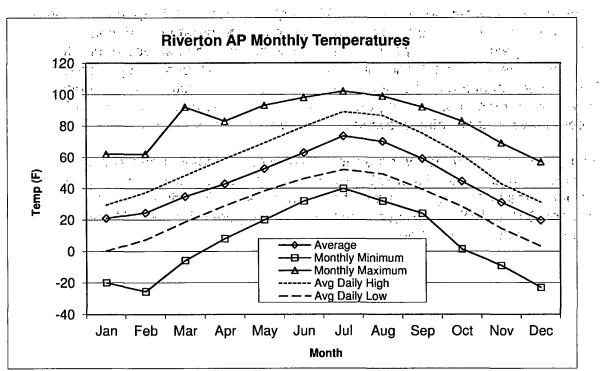
Large diurnal temperature variations occur in the region due in part to its high altitude and low humidity. Figure 2.5-3 depicts the monthly diurnal temperature variation for the Riverton AP site from November, 1996 through January, 2012. Spring and summer daily variations of 25° F are typical, with maximum temperature variations exceeding 40° F during extremely dry periods. Less daily variation is observed during the cooler portions of the year as fall and winter have average variations of approximately 15° F. This can be attributed to the more stable atmospheric conditions in the region during the fall and winter months. Stable periods have much lower mixing heights and accompanying lapse rates allowing for less temperature variation.

Figure 2.5-4 shows monthly temperature statistics for regional meteorological stations, with the Cameco Gas Hills on-site station included for reference. On a seasonal basis, temperatures in the region average between 20° and 30° F during winter months and between 60° and 75° F during summer months. In general, regional temperatures are inversely related to elevation.

		Temperature Statistics (° F)									
Month	Monthly Average	Monthly Maximum	Monthly Minimum	Ŭ	Average Daily Low						
Jan	21.0	·' 62	-20	29.5	0.3						
Feb	24.5	62	-26	37.4	7.3						
Mar	34.9	92	· -6	48.2	.18.6						
Apr	42.9	83	. 8	59.0	29.0						
May	52.6	93	20	69.2	38.5						
Jun	62.9	98	32	79.5	46.2						
Jul	73.5	102	4 0	88.8	51 <i>.</i> 9						
Aug	70.0	99	32	86.5	49.2						
Sep	59.1	92	24	. 75.3	39.4						
Oct	44.5	83	• 1	61.3	28.5						
Nov	31/2	69	-9	42.9	14.5						
, Dec	19.7	. 57	-23		3.2						

Source: National Climate Data Center, 2012, hourly data from 1996 through 2012

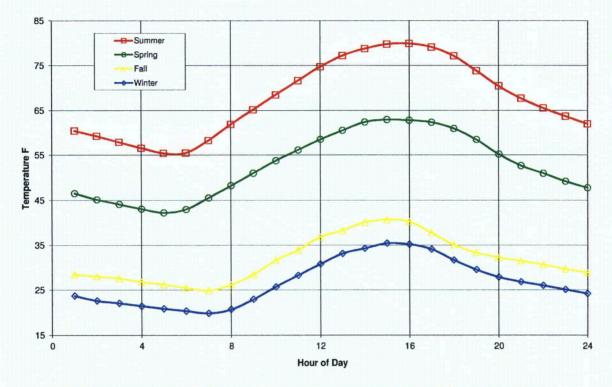
Table 2.5-2. Annual and Monthly Temperature Statistics for Riverton AP.



Source: National Climate Data Center, 2012, hourly data from 1996 through 2012

Figure 2.5-2. Riverton AP Monthly Temperature Statistics

Riverton Diurnal Average Temperature



Source: National Climate Data Center, 2012, hourly data from 1996 through 2012

Figure 2.5-3. Riverton AP Seasonal Diurnal Temperature Variations.

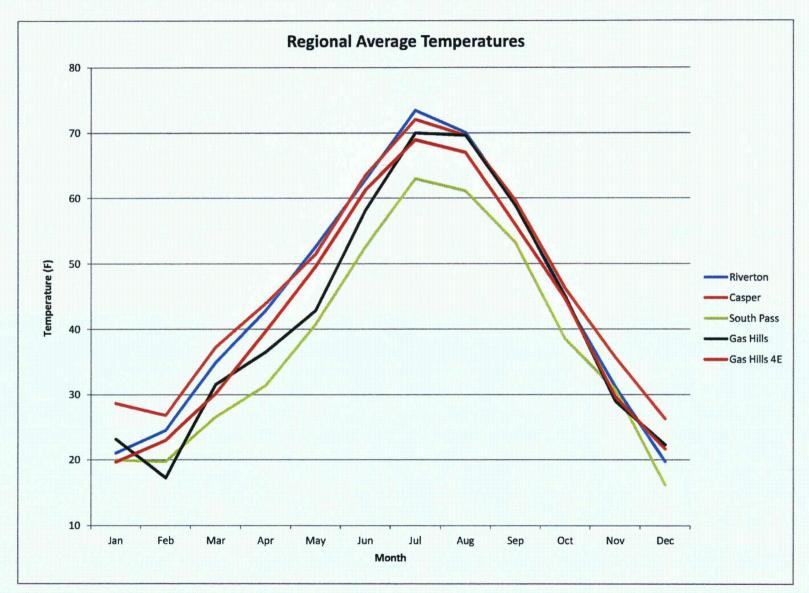
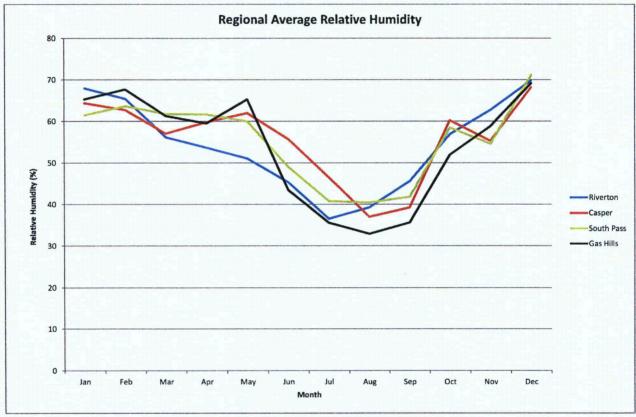


Figure 2.5-4. Regional Monthly Average Temperatures.

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Relative Humidity

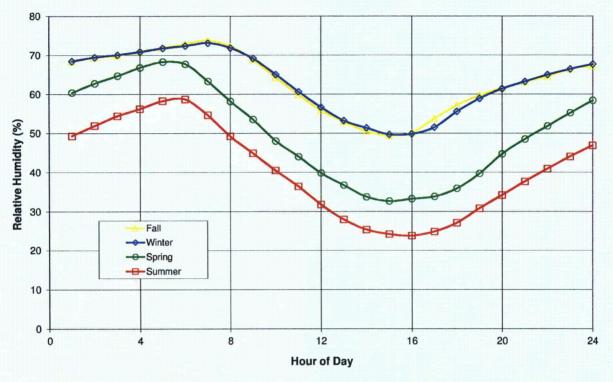
The Riverton, Casper, and South Pass sites record hourly average relative humidity. Figure 2.5-5 charts monthly average relative humidity values for these sites. The Cameco on-site (Gas Hills) relative humidity averages are also shown for reference. It can be seen that July and August have the driest air with relative humidity averaging around 40%. The winter months of December, January and February make up the most humid part of the year, with average relative humidity between 60% and 70%. The annual average relative humidity is 54% at the Riverton AP site.



Sources: NCDC, WDEQ, Cameco Resources

Figure 2.5-5. Monthly Relative Humidity Statistics for the Region

Relative humidity is a temperature based calculation which reflects the fraction of moisture present relative to the amount of moisture for saturated air at that temperature. Warmer air holds more moisture at saturation than colder air. For a given amount of moisture in the air, then, maximum relative humidity values occur more frequently in the early mornings while minimum values typically occur during the mid afternoon hours. The summer months exhibit a much greater variation in relative humidity between morning and afternoon values due to greater temperature variations. Figure 2.5-6 shows the diurnal variations in relative humidity at Riverton, by season.



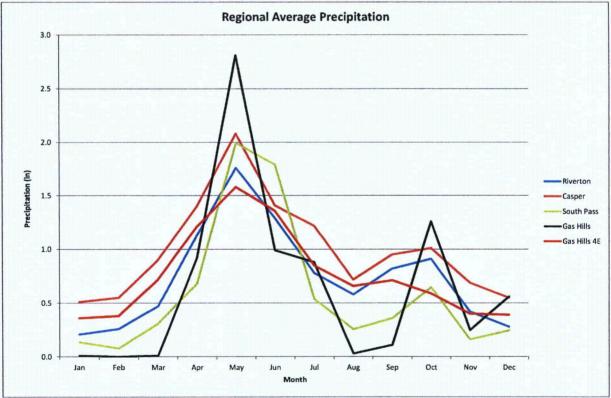
Riverton Diurnal Average Relative Humidity

Source: National Climate Data Center, 2012, hourly data from 1996 through 2012

Figure 2.5-6. Diurnal Variation in Relative Humidity for Riverton by Season

Precipitation

The region is semi-arid and characterized by mostly dry conditions. The Riverton AP site received measurable (>0.01 in) precipitation on an average of 64 days per year between 1997 and 2011 (NCDC, 2012). Average annual precipitation during that period was 8.9 inches per year. In general, the region has an annual precipitation average of approximately 8 to 12 inches. Typical of the region, spring snowstorms, showers and thunderstorms during April through June produce nearly half of the precipitation at the historical Gas Hills 4E site (Figure 2.5-7). May is typically the wettest month of the year; with most of the region receiving an average of approximately 2 inches for that month. January, in contrast, is the driest month of the year with precipitation typically averaging one half inch or less. The winter months (Dec-Feb) typically account for less than 15% of the yearly precipitation totals. Only moderate precipitation occurs in late summer, when atmospheric conditions are more stable and the absence of convective activity limits storm development.



Sources: NCDC, WDEQ, WRDS, Cameco Resources

Figure 2.5-7. Monthly Average Precipitation in Region

Severe weather does occur throughout the region, but is limited on average to 5 or 6 severe events per year. These severe events are generally split between hail, blizzards and damaging wind events.

Average annual snowfall varies widely throughout the region, as depicted in Figure 2.5-8. Major snowstorms (more than 5 in/day) are relatively infrequent in the region, which typically experiences less than three major snowstorms per year. Casper has the highest annual snowfall of the sites recording snowfall, with an average of 76.9 inches, while Riverton has the lowest average at 34.2 inches per year. Monthly average snow amounts in Figure 2.5-8 show the highest snowfall in March and April.

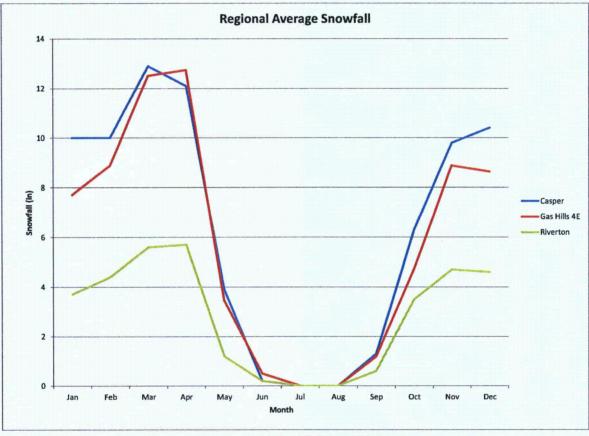




Figure 2.5-8. Regional Average Monthly Snowfall.

Wind Patterns

Year-round wind speeds in the area average between 8 and 14 mph. Table 2.5-3 shows monthly averages for the Riverton AP site. The overall average wind speed at this site was 7.4 mph for the 1996-2012 period analyzed in this study. Mean monthly average wind speeds are lowest in the winter months and highest in April at nearly 9 mph. This is atypical of the region, however, as winds at Riverton are moderated by the proximity of the Wind River mountain range.

	Hourly Ave	rage Wind Sp	eeds (mph)
Month	Monthly	Monthly	Monthly
	Average	Maximum	Minimum
Jan	6.5	43	0
Feb	6.5	41	0
Mar	8.2	39	0
Apr	8.8	39	۳ ^۰ 0
May	8.4	46	0
Jun	8.2	43	0
Jul	7.8	41	0
Aug	7.6	44	0
Sep	7.3	37	0
Oct	7.3	46	0
Nov	6.4	40	0
Dec	6.0	41	0

Source: National Climate Data Center, 2011, hourly data from 1996 through 2011

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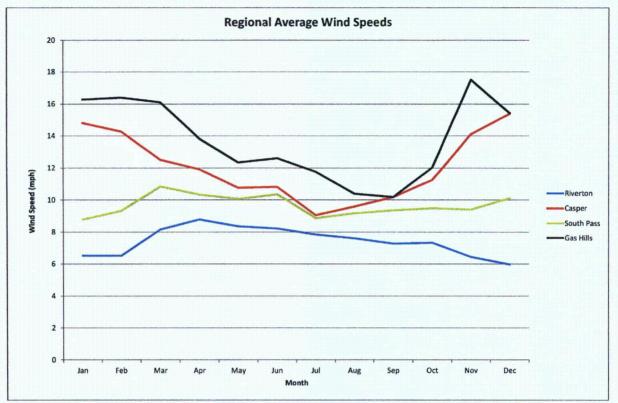
Table 2.5-3. Riverton AP Monthly Wind Parameters Summary.

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Figure 2.5-9 shows regional monthly average wind speeds. Like Riverton, the South Pass site also experiences a wind sheltering effect from the Wind River mountain range. Farther east, however, high wind events are fairly common from November to April. Winds at Casper average more than 12 mph, with hourly averages exceeding 20 mph nearly 15% of the time (NCDC 2012).

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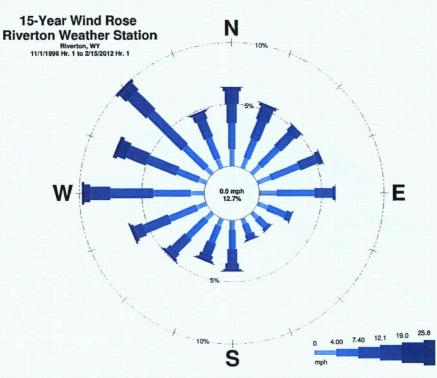
Sources: NCDC, WDEQ, Cameco Resources

Figure 2.5-9. Regional Average Wind Speeds

Figure 2.5-10 shows the 15-year wind rose for the Riverton AP site. Predominant winds are generally from the west to northwesterly direction. These winds are often associated with storm fronts during the late fall, winter, and spring seasons. Otherwise light breezes trend more or less evenly from all directions except the southeasterly sector.

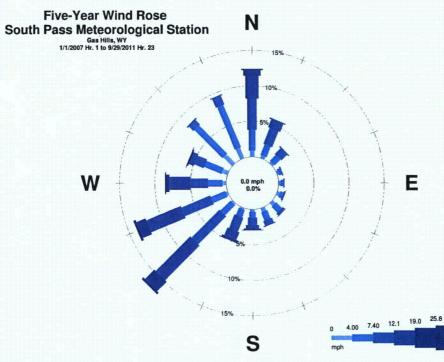
Figure 2.5-11 shows a 5-year wind rose for the South Pass site. Here, southwesterly winds dominate, with a secondary node from the northerly direction. Figure 2.5-12 shows an 8-year wind rose for the Casper site. Winds are much stronger at Casper than at South Pass and Riverton, with dominant southwesterly winds influenced by the nearby Casper Mountain.

Dramatic differences in terrain and elevation across the region make it impossible to assign a single wind pattern to all locations. Southwesterly flow emerges as the common wind characteristic in high and unobstructed areas. As discussed below in justifying the on-site baseline year as representative of the long term, spatial variations in wind patterns across the region are pronounced, while temporal variations for any given site are relatively minor.



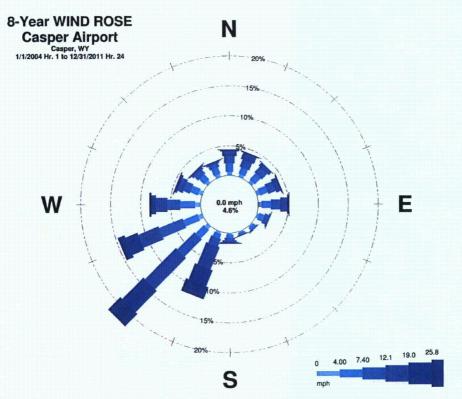
Source: National Climate Data Center, 2012, hourly data from 1996 through 2012

Figure 2.5-10. Riverton AP 15-Year Wind Rose



Source: WDEQ, hourly data from 2007 through 2011

Figure 2.5-11. South Pass 5-Year Wind Rose

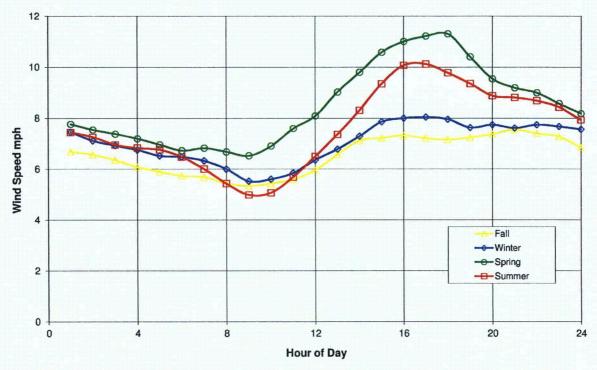


Source: NCDC, hourly data from 2004 through 2011

Figure 2.5-12. Casper 8-Year Wind Rose

Winds throughout the region exhibit a diurnal pattern. Figure 2.5-13 shows this pattern at Riverton for each season of the year. While the diurnal variation is less pronounced during the fall months, wind speeds peak during the late afternoon for winter, spring and summer seasons. This is largely due to the predominant effect of solar heating on wind patterns. Figure 2.5-13 also shows that the highest average wind speeds occur during the spring season, when the atmosphere tends to be least stable and storm systems are the strongest. The lowest wind speeds occur during fall, when the atmosphere is the most stable.

Riverton Diurnal Average Wind Speed



Source: National Climate Data Center, 2012, hourly data from 1996 through 2012

Figure 2.5-13. Riverton AP Diurnal Wind Speeds by Season

Heating, Cooling and Growing Degree Days

Figure 2.5-14 summarizes the monthly cooling, heating, and growing degree days for Riverton. The heating and cooling degree days are included to show deviation of the average daily temperature from a predefined base temperature. In this case, 55° F has been selected as the base temperature for computation of heating and growing degree days. The base temperature for computing cooling degree days is 65° F. The number of heating degree days is computed by taking the average of the high and low temperature occurring that day and subtracting it from the base temperature. The calculation for growing and cooling degree days is the same, except that the base temperature is subtracted from the average of the high and low temperature is subtracted from the average of the high and low temperature is subtracted from the average of the high and low temperature is subtracted from the average of the high and low temperature for the day. Negative values are disregarded for both calculations.

As expected, the graphs of heating degree days and cooling degree days are inversely related and the growing and cooling degree days are directly related. The maximum number of heating degree days occurs in December and January, at roughly 1,200 degree days per month. This coincides with the months having the lowest minimum average temperatures. Conversely, July registers the most growing degree days with nearly 500, and the most cooling degree days at less than 200. This also corresponds to July having the highest average temperature. The The Gas Hills Remote Satellite area is expected to exhibit a higher value for heating degree days and lower values for cooling and growing degree days, due to its higher elevation relative to Riverton.

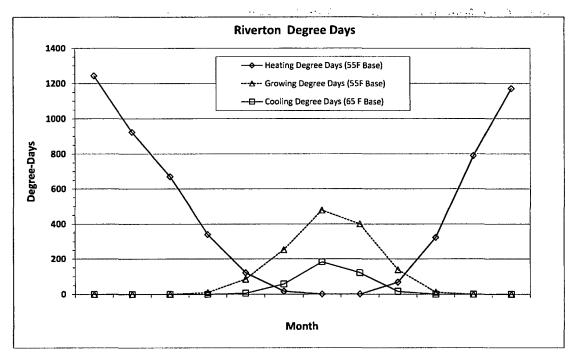


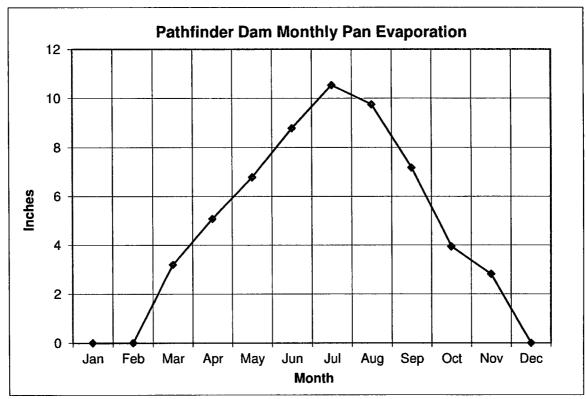


Figure 2.5-14. Riverton Airport Cooling, Heating, and Growing Degree Days.

Evapotranspiration

The region is characterized by high evaporative demand during much of the year. This demand is related to dry air (low dew points), warm daytime temperatures and moderate to high wind speeds. The Pathfinder Dam, roughly 40 miles eastsoutheast of the Gas Hills project site, is the closest station with historical evaporation data. With an elevation of 5,860 ft. and average annual precipitation of 9.8 inches, this site is believed to have average evaporation rates representative of the Gas Hills Remote Satellite area.

Figure 2.5-15 graphs monthly pan evaporation rates, measured in inches of water per month, at the Pathfinder Dam site. Evaporation rates are highest in July, at over 10 inches, and lowest in December through February. Annual evaporation at Pathfinder Dam averages 58 inches per year.



Source: WRCC, 1948-1991

Figure 2.5-15. Pathfinder Dam Pan Evaporation.

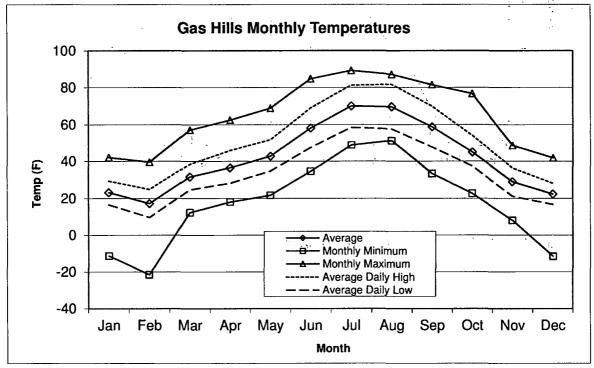
Site Specific Analysis

Background

The site specific discussion is limited to on-site meteorological data collected for the baseline monitoring period of December 8, 2010 through January 27, 2012. These on-site data are supplemented by meteorological data from the nearby Riverton AP site, collected during the 15-year period from late 1996 through early 2012. The Riverton site is included to incorporate wind monitoring results from a longer period of record and to demonstrate that for this region, winds during the baseline monitoring period are representative of the longer term. As the closest NWS weather station, the Riverton site is located less than 50 miles westnorthwest of the Gas Hills Remote Satellite. Notwithstanding its proximity, Riverton is over a thousand feet lower in elevation than the satellite area, and is surrounded by farmland in contrast to the generally dry and broken terrain of the satellite area.

Temperature

The annual average site temperature is similar to the regional average temperature at approximately 42° F. The maximum temperature for the baseline monitoring year was 89° F and the minimum temperature was -21° F. Figure 2.5-16 shows the monthly average, minimum and maximum temperatures for the project site. Table 2.5-4 provides the same data in tabular form. Daily average temperatures range from near 20° F in the winter months to near 70° in the summer months.



Source: Cameco Resources, 2012, data from 12/8/2010 to 1/27/2012

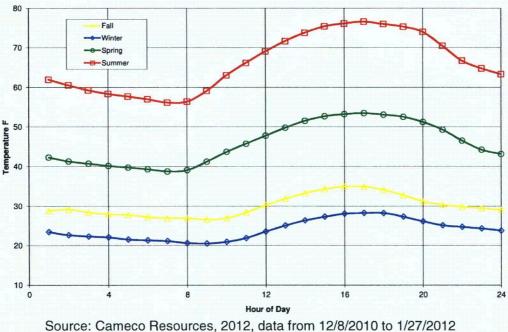
	Temperature Statistics (^e F)									
Month	Monthly Average	Monthly Maximum	Monthly Minimum	Average Daily High	Average Daily Low					
Jan	23.2	42	-11	29.4	16.5					
Feb	17.2	40	-21	24.9	9.6					
Mar	31.6	57	12	38.5	24.6					
Apr	36.5	63	18	45.9	28.2					
May	42.8	69	22	51.8	34.7					
Jun	58.2	85	35	69.1	47.6					
Jul	70.0	89	49	81.2	58.5					
Aug	69.6	87	51	81.7	57.6					
Sep	58.8	81	33	69.9	47.7					
Oct	45.0	77	23	54.2	37.4					
Nov	29.0	49	8	36.4	21.1					
Dec	22.3	42	-12	28.1	16.7					

Figure 2.5-16. Gas Hills Monthly Temperatures.

Source: Cameco Resources, 2012, data from 12/8/2010 to 1/27/2012

Table 2.5-4. Gas Hills Max, Min, and Avg Monthly Temperatures

Diurnal temperature variations at the Gas Hills Remote Satellite site are slightly less pronounced than at Riverton. Figure 2.5-17 shows diurnal swings ranging from 20° F in the summer to less than 10° F in the winter.



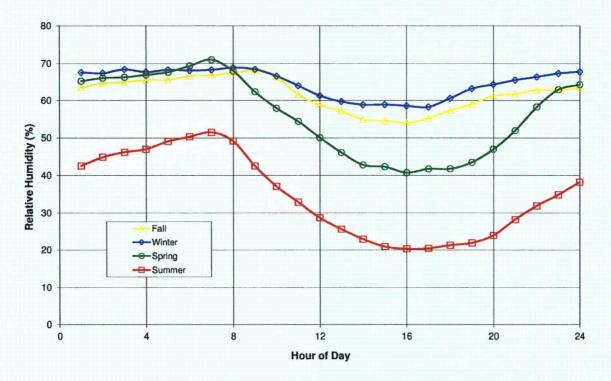
Gas Hills Diurnal Average Temperature

Figure 2.5-17. Gas Hills Monthly Temperatures.

Relative Humidity

The annual average site relative humidity is 55.4%. On-site monthly average relative humidity values are graphed along with regional averages in Figure 2.5-5. The graph shows relative humidity at the Gas Hills site to mirror regional trends.

Relative humidity is a temperature based calculation which reflects the fraction of moisture present relative to the amount of moisture for saturated air at that temperature. Warmer air holds more moisture at saturation than colder air. For a given amount of moisture in the air, then, maximum relative humidity values occur more frequently in the early morning hours while minimum values typically occur during the mid afternoon hours. The summer months exhibit a much greater variation in relative humidity between morning and afternoon values due to greater temperature variations. Summer and Spring also exhibit lower overall relative humidity values due to higher average temperatures. This is confirmed by Figure 2.5-18, which graphs average relative humidity by time of day and season.



Gas Hills Diurnal Average Relative Humidity

Figure 2.5-18. Gas Hills Diurnal Relative Humidity.

Source: Cameco Resources, 2012, data from 12/8/2010 to 1/27/2012

Figure 2.5-19 provides a meteorological summary for the Gas Hills Remote Satellite site for the baseline monitoring year. The averages, maximums, and

minimums are specified for each parameter recorded at the site along with the data recovery rate for each. The recovery rates were nearly 100% for all parameters.

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Meteorological Data Summary

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	Hourly Data					
	Average/Total	Max	Min			
Wind Speed (mph)	14.0	43.7	0.3	-		
Sigma-Theta (°)	16.8	98.3	, 1.0			
Temperature (F)	39.8	89.2	-21.4	*		
10m Temperature (F)	40.1	87.6	-18.7			
Relative Humidity (%)	55.4	100.0	6.6			
Precipitation_(mm)	247.65	14.48	:			
Solar Radiation (w/m^	2) 184.7	1,013.0	: .			

Predominant wind direction was from the SSW sector,

÷. ,	accounting for	20.7% of the possible winds			
<i>.</i> .	1.1		,	ī	

	Parameter	Possible	Reported	Recovery	
		(hours)	(hours)	•	
	Wind Speed	9962	9957	99.95%	
•	Wind Direction	9962	9955	99.93%	
	Sigma-Theta	9962	9957	99.95%	. ,
	Temperature	9962	9957	99.95%	
	10m Temperature	9962	9957	99.95%	
	Relative Humidity	9962	9957	99.95%	
	Precipitation	9962	9957	99.95%	• :
	Solar Radiation	9962	9957	99.95%	

Data Recovery

Figure 2.5-19. Gas Hills Meteorological Summary.

Wind Patterns

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Figures 2.5-20 presents a wind rose for the project site during the 13-month baseline monitoring period. The predominant wind directions are southsouthwesterly and southwesterly, with the highest wind speeds also coming from those directions. Figure 2.5-21 shows seasonal wind roses for the Gas Hills Remote Satellite area. Spring and summer experience the greatest variability in wind direction with secondary modes as a result of the synoptic scale transition period that occurs during this time. During periods of fair weather, particularly in late spring and summer months, high pressure located over the northern plains produces east-northeasterly breezes at the site. Synoptic weather systems generally interrupt this pattern, producing northwesterly winds.

Figure 2.5-22 presents a diurnal graph of wind speeds at the site by season. During the fall season, very little diurnal variation is observed. For the rest of the year, wind speeds peak during the late afternoon. Summer winds exhibit a secondary peak around midnight, possibly associated with downslope convection winds. Winds during the fall plateau at an average of 15 mph, while winter wind speeds average 16 mph and peak at 18 mph. The spring season exhibits the greatest average diurnal variation, from 11 mph at night to 16 mph in the afternoon.

Figure 2.5-23 shows the time distribution of wind speeds at the site. Half of the time wind speeds are more than 12 mph, while winds exceed 20 mph 16% of the time.

The average wind speed for the project site was 14 mph over the 13 months of monitoring. The monthly average and maximum hourly wind speeds at the project site are summarized in Figure 2.5-24. The graph shows lower wind speeds in the summer.

Figure 2.5-25 provides a breakdown of wind speeds by wind direction. Wind speeds average more than 15 mph when the wind blows from the south, south-southwest, and southwest directions. A secondary maximum occurs for east-northeasterly winds, averaging over 14 mph. Southeast wind speeds average less than 9 mph.

The Joint Frequency Distribution (JFD) provides more detail on wind speed distribution by wind direction and atmospheric stability class. The distribution shows the frequencies of hourly average wind speed for each direction based on stability class. Tables 2.5-5 and 2.5-6 list the annual JFD for the Gas Hills meteorological station. Tables 2.5-7 through 2.5-14 list the seasonal JFD's. A majority of the winds at the project site fall into stability class D which represents near neutral to slightly unstable conditions. The light-to-calm winds which accompany stable environments are reflected in the stability class F summary.

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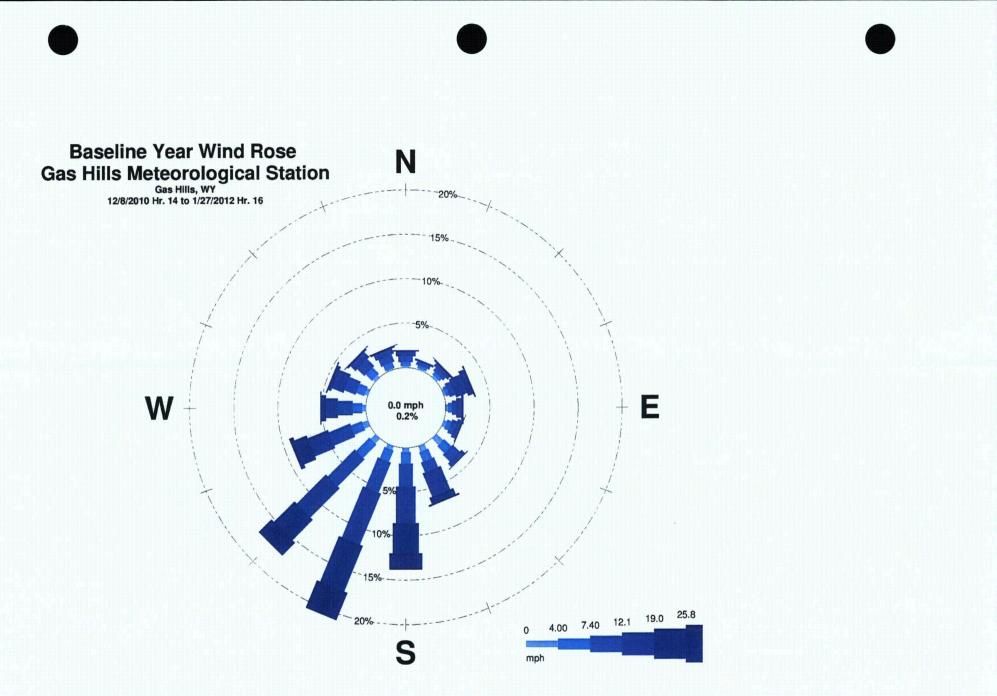


Figure 2.5-20. Gas Hills Wind Rose.

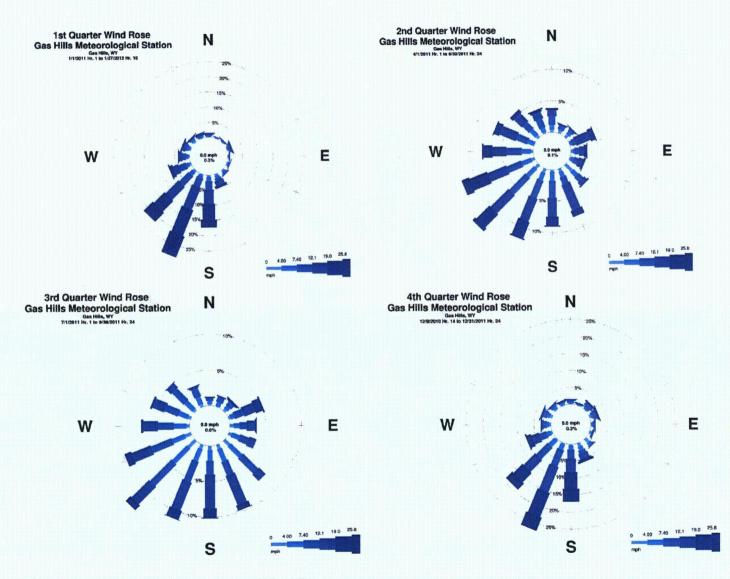


Figure 2.5-21. Gas Hills Seasonal Wind Roses.

Gas Hills Diurnal Average Wind Speed

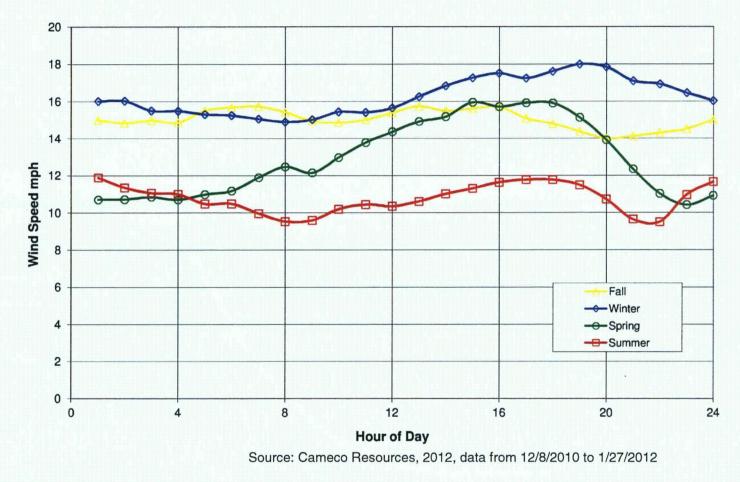
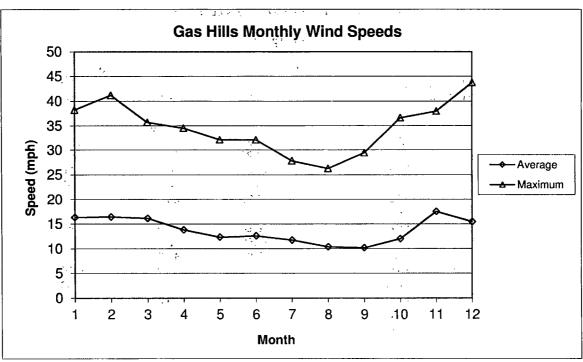


Figure 2.5-22. Gas Hills Diurnal Wind Speeds.



Figure 2.5-23. Gas Hills Wind Speed Distribution.



Source: Cameco Resources, 2012, data from 12/8/2010 to 1/27/2012

Figure 2.5-24. Gas Hills Monthly Average Wind Speeds



Wind Data Summary

12/8/2010 2:00:00 PM - 1/27/2012 4:00:00 PM

Hourly Data								
	Average	Max	Min					
Wind Speed (mph)	13.97	43.73	0.28					
Sigma Theta (º)	16.84	98.30	1.03					
Wind Direction		-						
N	9.90	23.69	1.04					
NNE	.8.33	19.40	0.66					
NE	10.25	29.19	0.28					
ENE	14.04	30.86	1.20					
Ε	10.85	34.82	1,35					
ESE	9.25	26.61	0.78					
SE	7.43	24.75	1.01					
SSE	12.26	36.30	0.65					
Ś	16.59	43.73	1.31					
SSW	17.65	42.31	0,96					
SW	15.17	42.94	0.55					
WSW	13.13	39.08	0.93					
W	11.24	33.34	0.66					
WNW	11:29	.32.71	1.51					
NW	9.75	31.97	0.66					
NNW	10.39	29.13	1.15					

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Predominant wind direction was from the SSW sector, accounting for 20.7% of the winds, the average wind direction was 210°.

Data Recovery

1. 1. 1

	Possible (hours)	Reported (hours)	Recovery
Wind Speed	9986	9957	99.71%
Sigma Theta	9986	9957	99.71%
Wind Direction	9986	9955	99.69%

Source: Cameco Resources, 2012, data from 12/8/2010 to 1/27/2012

Figure 2.5-25. Gas Hills Wind Summary.

Stability	Wind		Wind S	Speed (mph		e Year		
Class	Direction	< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	Row Tota
A	Ν	0.000490	0.000464					0.00095
	NNE	0.000490						0.00049
· ,	NE	0.000979	0.000464					0.00144
	ENE	0.000490	0.000928					0.00141
	E		0.001391	1				. 0.00139
	ESE	0.000979	0.001855					0.00283
	SE	0.000979	0.000464			·		0.00144
	SSE	0.001469	0.000928	-				0.00239
	S	0.000979	0.001855					0.00283
	SSW	0.000490	0.000464	· . ·				0.00095
	SW	0.001469	0.001855					0.00332
	WSW	0.001958	0.002319		1			0.00427
	W	0.002448	0.002319			17		0.00476
	WNW	0.001469	0.001391					0.00286
	NW	0.001958						0.00195
: /	NNW	0.001469						0.00146
B	N		0.000928					0.00092
	NNE		0.000464]				0.00046
	NE		0.000464		1.1			0.00046
	ENE		0.000464					0.00046
	E							
	ESE		0.000464					0.00046
	SE		0.000464					0.00046
	SSE		0.001391					0.00139
	S		0.000928	0.000464				0.00139
· · ·	SSW	0.000490	0.001391					0.00188
•	SW		0.000928					0.00092
	WSW		0.000464					0.00046
	W							
	WNW		0.001855					0.00185
	NW		0.000928		· .			0.00092
	NNW		0.000928	0.000464				0.00139
С	N		0.000464					0.00046
	NNE			0.000464				0.00046
	NE	[0.000928				0.00092
	ENE		0.000464	0.000928			······································	0.00139
	E			1	······			
	ESE							1
	SE			0.001391				0.00139
	SSE							
	S		0.001391	0.002783				0.00417
	SSW	0.000490	0.000464			1		0.00837
	SW		0.001391					0.00603
•	WSW	0.000490	the second s					0.00744
	W	1	0.002783				ra mayaan maalamaaliha saandaaliga ah	0.00603
	WNW	1	0.000464		·			0.00278
	NW		0.000464					0.00185
	NNW	T		0.000464				0.00046

 Table 2.5-5. Gas Hills Annual Joint Frequency Distribution.

Stability	Wind		Wind	Speed (mpl		e Year		
Class	Direction	< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	Row Tota
D	N		0.002783	0.001855	0.001391			0.006030
• .	NNE			0.001391	0.000464		······································	0.001855
	NE			0.002783	0.001855	0.000464	0.000464	0.005566
	ENE		0.001391	0.006494	0.006030	0.003247	0.000464	0.017625
4 ¹ . 1	E		0.000464	0.000464	0.002783	0.000928		0.004638
	ESE		0.002783	0.001855		0.001391		0.006030
	SE	0.000490	0.005102	0.001855	0.003711		a+	0.011157
.,	SSE		0.003711	0.010204	0.020872	0.005102	¥ [-•	0.040868
· .	S		0.005102	0.028293	0.067718		0.012987	0.147985
	SSW	0.000979	0.006494	and the second se	0.088126	0.083952		0.257937
	SW		0.010668	0.044991	0.054731	0.043599	0.015770	0.169759
	WSW	0.000490	0.006494	0.022727	0.013915	0.007421	0.001391	0.052438
	W	0.000490		0.015770	0.005102	0.002783	0.000464	0.028783
	WNW	0.000490	0.003711	0.004638	0.007885	0.003247	0.002319	
	NW		0.004174	0.002319	0.004174	0.000928	0.000928	0.012523
. ⁵⁵ 84	NNW			0.006494	0.003711	0.000464		0.010668
Έ	N		0.000464	Ì				0.000464
·	NNE				· · ·			
.•	NE		0.000928					0.000928
	ENE							
	E		0.000464		i			0.000464
• •	ESE		0.000464					0.000464
-	SE	0.000979					· · · · ·	0.001907
	SSE	0.000979	0.001855	0.000928				0.003762
	S		0.002783					0.006494
	SSW		0.000928		· · ·		• •	0.003711
	SW	0.000490	0.005102					0.007911
ì	WSW	0.000490	0.000928					0.005592
	W		0.001391	0.000464			1	0.001855
	WNW	0.000979	0.000464				-	0.001443
	NW		0.001391					0.001391
	NNW		0.001391					0.001391
, ĿĹ	N	0.000490	0.001391					0.001881
• •	NNE	0.001958	0.000928					0.002886
· .	NE	0.001958						0.001958
	ENE	0.001958	0.000464					0.002422
	E	0.001469	0.001391					0.002860
	ESE	0.001958	0.002783					0.004741
	SE		0.001391				·····	0.005308
	SSE	0.003427	0.003711					0.007138
•	S	0.003917	0.007421					0.011338
-	SSW		0.003247					0.005205
	SW		0.002319					0.008684
	WSW		0.002783					0.007679
	W		0.001391				- <u> </u>	0.003839
	WNW	<u></u>	0.002783				······································	0.004741
:	NW		0.001391	· · · · · · · · · · · · · · · · · · ·				0.004819
	NNW	0.000490						0.00049

Table 2.5-6. Gas Hills Annual Joint Frequency Distribution (continued).

Stability	Wind	Wind Speed (mph) - 1st Quarter								
Class	Direction	< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	Row Total		
A	N	0.000490	0.000464		. ⁻ • •	13.22.2		0.000953		
	NNE	0.000490		i. I				0.000490		
	NE	0.000979	0.000464			1		0.001443		
	ENE	0.000490	0.000928	2186 B 1 1		l		0.001417		
	Ē	1	0.001391	10 · · · ·	·····	1	••••••	0.001391		
	ÉSE	0.000979	0.001855			1		0.002834		
	SE	0.000979	0.000464		******			0.001443		
	SSE	0.001469	0.000928	5.29				0.002396		
	S	0.000979	0.001855			1	<u></u>	0.002834		
	SSW	0.000490	0.000464					0.000953		
	SW	0.001469	0.001855			1	·	0.003324		
	WSW		0.002319	·····				0.004277		
	W	0.002448	0.002319					0.004767		
	WNW	0.001469				1		0.002860		
	NW	0.001958						0.001958		
	NNW	0.001469				†		0.001469		
В	N	0.0001.000	0.000928			1		0.000928		
	NNE,		0.000464			1		0.000464		
	NE		0.000464			1		0.000464		
	ENE ·		0.000464		lanayaliddamayaan hir diby add Add			0.000464		
	E		0.000101				<u> </u>			
	ESE		0.000464		•			0.000464		
	SE		0.000464				<u> </u>	0.000464		
	SSE		0.001391		••• <u>•</u> ••••••••••••••••••••••••••••••••	1		0.001391		
	S		0.000928	0.000464		+	•	0.001391		
	SSW	0.000490	0.001391	0.000-0-		·	<u> </u>	0.001881		
	SW	0.000430	0.000928				<u> </u>	0.000928		
	WSW		0.000328					0.000320		
	W		0.000404					0.000404		
	WNW		0.001855		, 			0.001855		
	NW		0.000928			· {· {·		0.000928		
	NNW	h	0.000928	0.000464				0.001391		
<u> </u>		·	0.000928	0.000404				0.000464		
С			0.000404	0.000464			<u> </u>	0.000464		
		·		0.000484		-		0.000404		
	ENE		0.000404			4				
	E		0.000464	0.000928		<u>+</u>		0.001391		
						}	+			
	ESE			0.001001		1.1	÷	0.001201		
	SE			0.001391				0.001391		
	SSE S		0.004004	0.000700		,	<u> </u>	0.004174		
		0.000400	0.001391					0.004174		
	SSW	0.000490	0.000464			+		0.008375		
	SW	0.000100	0.001391			1		0.006030		
	WSW	0.000490		0.006030			+	0.007447		
	W_	ļ	0.002783					0.006030		
	WNW		0.000464				<u></u>	0.002783		
	NW		0.000464	and the second se	and the second sec	·	1	0.001855		
	NNW		ABAZAR	0.000464		<u> </u>	<u> </u>	0.000464		

 Table 2.5-7. Gas Hills Winter Joint Frequency Distribution.

Stability	Wind	Wind Speed (mph) - 1st Quarter						<u> </u>	
Class	Direction	< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	Row Total	
D	N		0.002783		0.001391			0.006030	
	NNE			0.001391			, , , , , , , , , , , , , , , , , , , 	0.001855	
	NE				0.001855	0.000464	0.000464		
	ENE		0.001391		0.006030		0.000464		
	Ę		0.000464	0.000464		a surprise and a surprise of the surprise of t		0.004638	
	ËSE		0.002783	0.001855		0.001391		0.006030	
	SE	0.000490	0.005102		0.003711			0.011157	
	SSE		0.003711		0.020872	0.005102		0.040868	
	S.		0.005102	0.028293			0.012987	0.147985	
•.*	SSW	0.000979			0.088126	a second s		the second s	
	SW		0.010668		0.054731				
	WSW	0 000490	0.006494		0.013915		0.001391	0.052438	
	W		0.004174						
. ۲۰	WNW	0.000490			0.007885		0.002319		
• •	NW		0.004174		0.004174		0.000928		
	NNW			0.006494		0.000464	1	0.010668	
E	N		0.000464	0.000101	0.000711	0.00010,1	15 1	0.000464	
- .	NNE [,]		0.000101			1			
	NE		0.000928			a de la dela		0.000928	
	ENE		0.000020			1. 1.			
	E.		0.000464					0.000464	
	ESE		0.000464					0.000464	
	SE /	0 000979	0.000928					0.001907	
	SSE	0.000979		0.000928				0.001307	
	S	0.000373	0.002783	0.003711				0.006494	
	SSW		0.000928	0.002783				0.003711	
	SW	0 000490	0.005102	0.002319				0.007911	
	WSW	0.000490					·····	0.005592	
	W	0.000430	0.001391	0.000464				0.001855	
	WNW	0.000979		0.000404				0.001443	
	NW	0.000375	0.001391					0.001391	
	NNW		0.001391					0.001391	
F	N	0.000400	0.001391			7 (* 1. 1 . 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.		0.001391	
. г.			0.000928		·····	·····		0.002886	
	NE	0.001958	0.000320					0.002000	
	ENE		0.000464					0.001938	
	ENE		0.001391					0.002422	
			0.002783			The second		0.002800	
	SE		0.001391					0.005308	
	S			······································				0.011338	
	SSW		0.007421	·····			· · · · · · · · · · · · · · · · · · ·	0.005205	
		·						0.005205	
	SW WSW		0.002319	And the second se				0.008684	
	W								
	WNW		0.001391			····		0.003839	
			0.002783			·			
	NW .	and the second	0.001391					0.004819	
	NNW	0.000490			L	L	10 to 1/27	0.000490	

Source: Cameco Resources, 2012, data from 12/8/2010 to 1/27/2012

Table 2.5-8. Gas Hills Winter Joint Frequency Distribution (continued).

A second second second second second

Stability	Wind	Wind Speed (mph) - 2nd Quarter							
Class	Direction	< 3	4-7	8 - 12	13 - 18	19 - 24	> 24	Row Tota	
A	N	0.000933	0.001832	· · · · · ·	÷ .			0.00276	
	NNE	0.001399	0.000458					0.001857	
	NE	0.003265	0.000916	1				0.00418	
	ENE	0.000466	0.001832	1010 -				0.002299	
	E	0.000933	0.000458	1 . Q				0.00139	
	ESE				1. S.				
	SE	0.001399	1	•				0.00139	
	SSE	0.000466	0.001374	,		-		0.00184	
	S	0.000466	0.002290		:			0.00275	
	SSW		0.002749					0.00414	
	SW	0.001866	0.003665		· · ·			0.00553	
	WSW		0.005039		', a 📜			0.00550	
	W	0.001399	0.004123		1.3	*1 ¹		0.00552	
	WNW ·	5 N. S. S	0.002749			· · · · · · · · · · · · · · · · · · ·		0.00274	
	NW	0.001866	0.004581	1	·			0.00644	
	NNW		0.003207					0.00320	
В	N		0.003207	0.000458				0.00366	
	NNE		0.002749					0.00274	
	NE		0.000458				·····	0.00045	
	ENE			0.000458				0.00045	
	E		0.000458					0.00045	
	ESE	0.000466	0.001374				·····	0.00184	
	SE	0.000466	0.000916	0.000458				0.00184	
	SSE) 	0.000458			1		0.00045	
	S		0.002749		e e posse e pos		· · · · · · · · · · · · · · · · · · ·	0.00274	
	SSW	(i	0.001832	0.000916				0.00274	
	SW		0.001374	0.000458				0.00183	
	WSW	0.000933	0.001374		······································	1		0.00230	
	W		0.005955					0.00595	
	WNW		0.004123	0.000916		Carlot in		0.00503	
	NW		0.004123	0.000458	·	Cres 3		0.00458	
	NNW		0.004581	0.000458				0.00503	
С	N			0.007787		1		0.00778	
	NNE			0.001374				0.00137	
	NE	1	0.000916	0.000458				0.00137	
	ENE		0.000458	0.001832		, ,		0.00229	
	E	1		0.002749		τ.		0.00274	
	ESE			0.002290				0.00229	
	SE	0.000933	0.000916	0.002290	ar deleter hymne i feld anneren an deler med formale on order			0.00413	
	SSE			0.000916				0.00091	
	S			0.004581		1.		0.00458	
	SSW		0.001374					0.01053	
	SW	<u> </u>	0.000916					0.00824	
	WSW	†	0.001832			+		0.01053	
	W - 1 - 1		0.002290			1	ata	0.01145	
	WNW	+	0.001832				210 Ju	0.01053	
	NW	0.000466	0.001832					0.01146	
	NNW	1	0.000458			· · · · · · · · · · · · · · · · · · ·		0.00458	

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Table 2.5-9. Gas Hills Spring Joint Frequency Distribution.

Stability	Wind		Wind	Speed (mp	h) - 2nd Qu	larter		······································
Class	Direction	< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	Row Total
D	N ^{2.5}		0.004123	0.007329	0.007329	0.000916		0.019698
	NNE		0.001374	0.003207	0.001832			0.006413
	NE		0.000916	0.003665	0.001374	0.000458	·	0.006413
	ENE		0.000458	0.008704	0.022446	0.003207	0.000458	0.035273
	E lor			0.006871	0.006871	.0.002749	0.000458	0.016949
	ESE		0.001832	0.005039	0.005497	0.001374		0.013743
	SE	0.002332	0.002290	0.007787	0.002749	0.001832	·	0.016991
	ŞSE	0.002332	0.004581	0.027943	0.026569	0.005039		0.066464
	S		0.005497	0.025195	0.028401		.0.000458	0.066880
	SSW		0.008246	0.025195	0.036189		0.001832	0.087952
:	SW	0.000466	0.013284	0.029317	0.036647	0.022446		0.104452
	WSW		0.006871	0.020156	0.029317	0.025195		0.089785
	W	0.000466	0.003207	0.020614	0.019240	0.006871	0.001374	0.051772
	WNW	0.000466		0.017407	0.020156	0.003665	0.000916	0.047191
	NW		0.003207	0.011910	0.010078		21 14	0.027943
	NNW	0.000466	0.004581	0.007329	0.007329	0.003207		0.022913
E	Nece		0.000458					0.000458
	NNE							
	NE		0.000916			· · · · ·		0.000916
	ENE		0.000916					0.000916
	E		0.000458					0.000458
	ESE		0.002290					0.002290
	SE	0.000933	0.003665	0.000458			•	0.005056
	SSE		0.001832	0.003207				0.005039
	Ş		0.004123	0.002749				0.006871
	SSW		0.002749	0.001832	1.4	···		0.004581
	SW	0.000466	0.005955	0.003665				0.010086
	WSW	0.000466	0.004581	0.001374	51 A 1 A			0.006422
	W		0.001374	0.000458				0.001832
	WNW		0.001374					0.001374
	NW		0.000916					0.000916
	NNW		0.000916					0.000916
F `-	N	0.003265	0.000916					0.004181
	NNE	0.002332						0.002790
	NE	0.002798			• • •			0.004173
	ĘNE	0.000466						0.001383
	E	0.002332						0.004164
	EŞE	0.001866						0.004614
1	SE		0.004581					0.013909
	SSE	0.002798	0.002749					0.005547
	S	0.002798	0.003665					0.006463
	SSW	0.005597	0.002749					0.008345
	SW	0.004664	0.002290					0.006955
-	WSW	0.003731						0.006938
	W	0.002332				1		0.005081
	WNW		0.000916					0.000916
,	NW	0.002332	0.000916					0.003248
	NNW	0.002332						0.003706

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Source: Cameco Resources, 2012, data from 12/8/2010 to 1/27/2012

 Table 2.5-10. Gas Hills Spring Joint Frequency Distribution (continued).

Stability	Wind			Speed (m	oh) - 3rd Qu			
Class	Direction	< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	Row Total
Α	N	0.001822	0.002266			1. N. 19		0.004087
	NNE	0.000911	0.001812					0.002723
Ś	NE	.0.002277	0.001812	s dest		· ·		0.004089
	ENE :	0.000911	0.000453	14 A.		1		0.001364
	E	0.002277	0.001812			1	· · · · · · · · · · · · · · · · · · ·	0.004089
	ESE	0.000911		1.4.1		1		0.003176
	SE .	0.002732	0.002719					0.005451
	SSE	0.002277				1 .	, ·	0.005902
	S	0.001822	0.004531	1. 15.1		· ·		0.006353
	SSW 1	0.001822		· · · ·	,	1		0.006806
	SW	0.002732			·····	ŀ	· · ·	0.009982
	WSW	0.005009		•				0.010900
	W	0.002732				1 1 1 1		0.011794
	WNW	0.003188					1	0.009078
	NW	0.002277				1		0.008620
	NNW	0.002732				1 21	[0.008623
В	N		0.000906	0.000453		1.0		0.001359
_	NNE	j	0.004078			12 (1) 12 (1)	1	0.004531
	NE		0.002266			E		0.002266
	ENE	0.000455				1		0.001815
	E	0.000455	0.000906		·····	35	1 1 1	0.001362
	ESE		0.001359		······································	+		0.001359
:	SE		0.002266			<u> </u>	<u></u>	0.002266
	SSE	0.000455	0.000453	0.000453		× 1	<u> </u>	0.001362
-	S.	0.000.00	0.002719	01000.00				0.002719
:	SSW		0.004531	<u>`````````````````````````````````````</u>		1	·····	0.004531
	ŚW		0.004984	0.000906		1	<u> </u>	0.005890
	WSW		0.010874	0.002266	·····		16	0.013140
	W		0.011328			· ·		0.012234
	WNW	0.000455	0.009062	0.000000				0.009517
	NW	0.000455	0.008156	0.001812				0.010424
	NNW		0.004078	0.000453		+	<u> </u>	0.004531
C	N		5.00 10,0	0.001359		1 3 5	e	0.001359
~	NNE	+		0.003625			<u>+</u>	0.003625
	NE	·}		0.001812			<u> </u>	0.001812
	ENE	<u> </u>	0.000453	0.004531			[0.004984
	E	<u> </u>	0.000906	0.002719	}	<u> </u>	÷	0.003625
	ESE	<u> </u>	0.000906	0.002719		+	<u>+</u>	0.003625
	SE	+	0.000453			+	<u>+</u>	0.003023
	SSE	+	0.000906				+	0.003625
	S	+	0.000453				·	0.003023
، ۱.	SSW	+	0.000433				+	0.004078
:	SW	0.000455	0.000906	0.013593	*** *********************************	+	<u> </u>	0.014955
	WSW	0.000435	0.000908			·		0.014955
	W	+	0.001359	0.012234				0.012687
	WNW.	0.000455	0.001359			+		0.015406
	NW 3	0.000435	0.001339	and the second state of th		+	1	
	NW NNW	ļ		0.011328		<u>.</u>	ļ	0.011328

Source: Cameco Resources, 2012, data from 12/8/2010 to 1/27/2012

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 Table 2.5-11. Gas Hills Summer Joint Frequency Distribution.

Stability	Wind	· · · · ·	Winc	Speed (mr		arter	·····	یں بی دو اور اور اور اور اور اور اور اور اور او
Class	Direction	< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	Row Total
	N	<u> </u>	0.000906	0.002266	10 10	13-24	<u> </u>	0.003172
- U	NNE		0.001359	0.001359	0.000453		,t i i j	0.003172
	NE		0.000906	0.003172	0.001812		0.000453	0.006797
-	ENE		0.002266	0.011328	0.014499		0.000453	
	E	0.000455	0.002266	0.008156	0.009515			0.021751
	ESE	0.000455	0.004984	0.009968		0.000300	0.000433	0.020843
, ,	SE	0.000455		0.021296	0.006343		· · · .t	0.020845
	SSE	0.000455		0.025374	0.032623			0.068423
	SSE S			0.025374	0.032623			0.068423
	SSW	0.000455	0.009968	0.020092		0.003625		0.079293
	SW	0.000455			0.026280		0.000455	0.077930
	WSW SW			0.021749				
	L	0.000455		0.018124		0.005437		0.050750
-	W .		0.000906	0.009515	0.013140			0.024468
	WNW		0.000906	0.007250	0.011781			0.020390
	NW		0.002719		0.004984			0.014952
	NNW	0.000455	0.002719	0.003625	0.001359	0.000453		0.008156
E 🖪	N	0.000455	0.001359					0.001815
	NNE		0.000906					0.000906
•	NE		0.001359			(,)		0.001359
	ENE		0.000453					0.000453
	E	0.000455	0.002266					0.002721
	ESE	0.000911	0.002719	0.000453		•		0.004082
1	SE		0.007250	0.004078		1		0.011328
	SSE		0.004531	0.004531			· · · · ·	0.009062
	S	0.000455	0.001359	0.001359				0.003174
	SSW		0.005890	0.000906		2		0.006797
	SW	0.000455		0.005890	· · · · · ·			0.015861
	WSW	0.000911	0.002266	- -				0.003176
	W		0.002266			- <u>3(</u>		0.002266
	WNW		0.000453			1		0.000453
	NW		0.002266				, <i>1</i>	0.002266
1	NNW		0.002266					0.002266
F	N	0.000455	0.000453		·. · ·			0.000908
	NNE		0.001359		New CORE			0.001359
	NE	0.001366	0.000906					0.002272
	ENE	0.001366			-G			0.005444
	E.	0.001822	0.002266		.4.			0.004087
	ESE	0.003643	0.003172					0.006815
	SE	0.007741	0.009968					0.017710
	SSE	0.003643	0.005890	ĺ		1.1.1		0.009533
	S		0.003172					0.006359
	SSW		0.003172	i	· ·	1		0.007270
	SW		0.005890		· · · · · · · · · · · · · · · · · · ·	Ì		0.014998
	WSW		0.004078					0.007266
	W		0.000453			· .		0.002275
	WNW		0.001359				· · · · ·	0.001815
	NW		0.003172		-			0.003627
						1	ł	0.000027

Source: Cameco Resources, 2012, data from 12/8/2010 to 1/27/2012

 Table 2.5-12. Gas Hills Summer Joint Frequency Distribution (continued).

Stability	Wind		Wind	Speed (m	oh) - 4th Qu	uarter		
Class	Direction	< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	Row Total
Α	Ν	0.000352	0.000683	ê Niştî		3.5		0.001035
	NNE	0.001055	0.000342					0.001397
	NE	0.001407	0.001025	5. est 1	a NA ANA			0.002432
	ENE	0.001055		1 I I I		3		0.001055
	E	0.001055	0.000342			1		0.001397
	ESE	0.000352	Î	N NE T			· .	0.000352
	SE	0.001055	0.000683		1. A. T. A.			0.001738
	SSE	0.001055	0.000683			<u> </u>		0.001738
	S and the	0.001055	0.003415			ſ		0.004471
	SSW		0.002732		4 A. M.			0.002732
	SW	0.000703	0.002732		1999 - S. 19			0.003436
	WSW	0.002814	0.002732				1 - 1 ¹	0.005546
	W	0.002110	0.003757			1953		0.005867
	WNW	0.002110	0.002732		19 A. 19 A.	1		0.004843
	NW	0.002462	0.002391					0.004853
	NNW	=0.000703	0.001708					0.002411
В	N		0.000342				1.5	0.000342
	NNE ?		0.001366	0.000342				0.001708
	NE		0.001366			1 .		0.001366
	ENE		0.001025			1		0.001025
	E		0.000683	0.000342		1	,	0.001025
	ESE		0.000683					0.000683
	SE		0.001025		1.11.2	1		0.001025
	SSE	0.000352	0.001025			1	,	0.001376
	S ···	{	0.001366					0.001366
	SSW		0.002732	0.000342	1.1	1.9.	<u></u>	0.003074
	SW	0.000352	0.004098		1.5 00	1		0.004450
	WSW		0.004440	0.000683	1	1		0.005123
	W	0.000352		0.000342	1	1.1.1.1		0.004792
	WNW		0.004098	0.000683	[·····	1.1.1		0.004781
	NW	0.000352						0.003767
	NNW		0.003074			1.0	-	0.003074
С	N			0.001366	[1	0.001366
	NNE	†	0.000683	0.002391		1	<u>}</u>	0.003074
	NE		0.001366	0.001025		1		0.002391
	ENE "		0.000683	0.002732	· ·	1. 0		0.003415
	E		0.000683	0.002049	1	1	1	0.002732
	ESE			0.001366			1	0.001366
	SE	1		0.000683	****	111.	T	0.000683
	SSE	1	0.000342			1,	1	0.000683
	S	1	0.000342				1	0.002049
	SSW -	1	0.000342				1	0.003415
	SW	0.000703					· · ·	0.005143
	WSW	0.000352				<u> </u>	1 2 25 1	0.008548
	W	1	0.000683			1		0.006489
	WNW	0.000703				+	1	0.009583
	NW	1	0.000342			· ·	1	0.005123
	NNW		0.000342			1.	1	0.001025

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Source: Cameco Resources, 2012, data from 12/8/2010 to 1/27/2012

Table 2.5-13. Gas Hills Fall Joint Frequency Distribution.

ability	Wind		Wind		oh) - 4th Qu			
lass	Direction	< 3	4-7	8 - 12	13 - 18	19 - 24	> 24	Row Total
D	N 6. 20		0.001708		0.003074	0.000342		0.008197
	NNE		and the second s	0.002049			Çirin di	0.005123
	NE :		0.002049	0.004440	0.008880	0.001708	0.000342	
	ENE		0.002049	0.007514	0.014344	0.005806	0.000683	0.030396
	E ::		0.002049	0.004098	0.004781	0.000683	0.000342	0.011954
	ESE	0.000352	0.001708	0.004098	0.003074		0	0.009232
	SE	0.003517	0.002049	0.010929	0.000683			0.017179
	SSE	0.001759			0.011612	0.002391	0.002732	0.041718
	S	0.000703			0.037568			0.126045
	SSW				0.074112			
	SW	0.001055		0.038251		0.018784		
	WSW			0.021858		0.010587		
	W	5.0000L		0.007855		0.002391		
	WNW	0.000352		0.006831		0.001025	0.000012 215	0.012988
	NW	5.0000Z	0.002391		0.002391			0.009904
	NNW		0.001025			0.000683		
E	N	0.000352	0.001023	0.002102	0.000074	0.000000	0.0000.42	0.002059
C	NNE	0.000332	0.000342					0.000342
	NE			0.000342	and the second	- in the		0.001366
		0.000050				<u></u>		
	ENE		0.000342	0.000342		·····		0.001035
	E		0.001366			·····		0.001718
	ESE		0.001366					0.002421
	SE		0.003415			<u> </u>		0.006520
	SSE		0.003415			· 0	·····	0.008569
	S.		0.002391	0.005123				0.007865
	SSW			0.003757				0.012988
	SW :::		0.009904					0.017097
	WSW		0.001366	0.000683	Second Second Second			0.002401
	W		0.001366		1.1.1.0			0.001718
	WNW	0.000352				<u> </u>		0.000693
	NW			0.000342				0.002049
	NNW		0.001708					0.002059
F	N		0.001366					0.002070
	NNE	0.000703	0.001025					0.001728
	NE	0.000703	0.001025					0.001728
	ENE		0.001708					0.003818
	E		0.002049		1	; ;·. ,		0.004863
	ESE	0.004221			1	····		0.006612
	SE		0.005806					0.012489
	SSE		0.004098	···				0.009023
	S		0.002391		· · · · · · · · · · · · · · · · · · ·			0.005908
	SSW		0.003757					0.007274
	SW		0.006148					0.010720
	WSW		0.001708					0.005225
	W		0.001708					0.00322
	WNW		0.001708					0.003480
	NW .		0.001366				**************************************	0.004552
		• • • • • • • • • • • • • • • • • • •			, . <i>.</i>		1	1 0.002421

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Source: Cameco Resources, 2012, data from 12/8/2010 to 1/27/2012

 Table 2.5-14. Gas Hills Fall Joint Frequency Distribution (continued).

Atmospheric Stability Class

The σ_{θ} method was used to determine the Pasquill-Gifford stability class, where σ_{θ} refers to the standard deviation of the horizontal wind azimuth angle in degrees. This method is also referred to as the σ_{A} method (EPA 2000). It is a lateral turbulence based method which uses the standard deviation of the wind direction in combination with the scalar mean horizontal wind speed. Wind speed and direction data are recorded hourly at a height of 10 meters. To minimize the effects of wind meander, the 1-hour σ_{θ} is defined using 15-minute σ_{θ} values which are in turn based on more frequent sampling of wind direction (e.g. every five seconds).

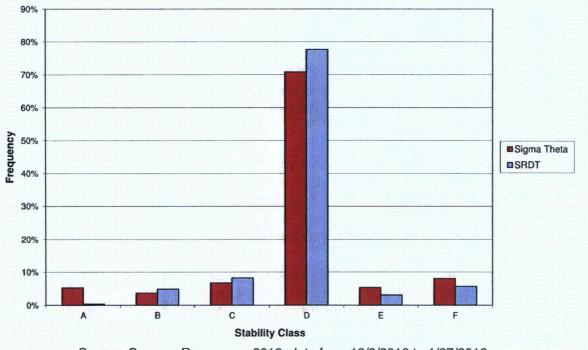
According to this method, initial stability classes are assigned based solely on standard deviation of wind direction, or σ_{θ} . The initial assignments are then adjusted for horizontal wind speed. The magnitude of this adjustment depends on whether the measurement is taken during daylight or nighttime hours, a diurnal dependency that varies with the time of year.

Regulatory Guide 3.63 (NRC, 1988) states: "For obtaining an indication of the atmospheric stability, a method such as one of the following (Refs. 1-4) may be used: insolation cloud cover and wind speed (Pasquill-Gifford and similar methods), temperature lapse rate method, wind fluctuation method, split-sigma method, or Richardson Number." The σ_{θ} method is based on wind fluctuation and therefore qualifies as an appropriate method for the Gas Hills Remote Satellite.

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In order to demonstrate its reliability, a comparison was made between the σ_{θ} method and the SRDT (Solar Radiation Delta Temperature) method at the Gas Hills site. Figure 2.5-26 shows this comparison. It can be seen that the two methods yield similar distributions. The percent of time characterized by stable air classes (E and F) is slightly higher for the σ_{θ} method. Given that stable air is less subject to dispersion than neutral or unstable air, it is expected that for Gas Hills the σ_{θ} method will result in more conservative modeling predictions than the SRDT method.



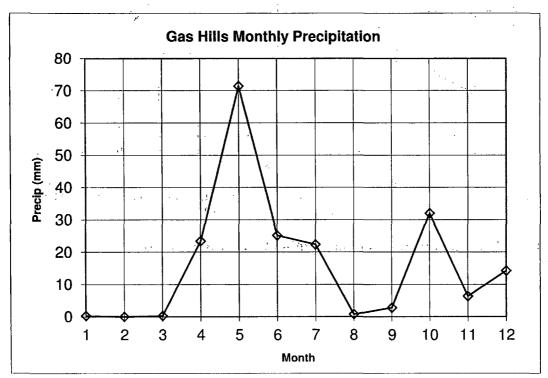
Gas Hills Met Station Stability Class Distribution

Figure 2.5-26. Gas Hills Stability Class Method Comparison.

Source: Cameco Resources, 2012, data from 12/8/2010 to 1/27/2012

Precipitation

Figure 2.5-27 shows monthly precipitation at the site during the baseline monitoring year. Total precipitation was slightly less than 200 mm (7.8 inches), with a third of that falling during the month of May. Very little precipitation fell during the late summer and winter months. Based on long-term records at other weather stations in the region, precipitation recorded during the baseline monitoring year may be slightly less than that expected over the long term. A 20-year, annual average precipitation of 9.2 inches was recorded at the nearby historical Gas Hills 4E station (1970 to 1989).

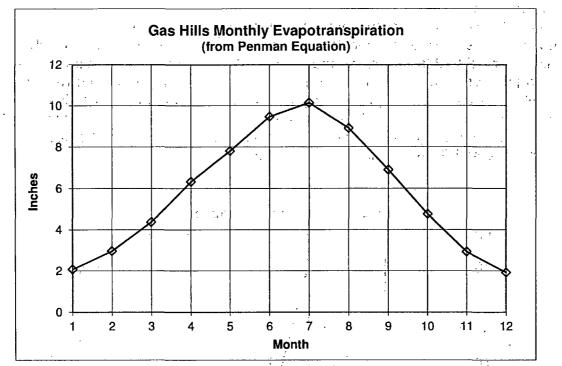


Source: Cameco Resources, 2012, data from 12/8/2010 to 1/27/2012

Figure 2.5-27. Gas Hills Monthly Precipitation.

Evapotranspiration

No pan evaporation measurements were available at Cameco's Gas Hills station. Daily evapotranspiration rates were calculated for the site by applying Penman's equation to recorded solar radiation, wind speed, temperature and relative humidity data. These calculations were then summed for each month. Figure 2.5-28 shows projected monthly evapotranspiration at the project site during the baseline monitoring period. From these calculations, annual evapotranspiration is approximately 68 inches. Excluding the months of December through February, the total of 61 inches compares favorably to the long-term average pan evaporation of 58 inches at the Pathfinder Dam site 40 miles away (no pan evaporation was measured for December through February).



Sources: Calculation based on Penman Equation, from data supplied by Cameco Resources, from 12/8/2010 to 1/27/2012

Figure 2.5-28. Gas Hills Potential Monthly Evapotranspiration.

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Justification of Baseline Year as Representative of Long Term

The Gas Hills Remote Satellite is situated in west-central Wyoming. The baseline meteorological monitoring period extended approximately one year, from December 8, 2010 through January 27, 2012. To demonstrate that this baseline year is representative of the longer term wind conditions, the Riverton AP site was analyzed. Among the weather stations in this region with available wind data, the Riverton AP was selected as the closest to Gas Hills. Riverton is less than 50 miles south of the project site, with an elevation roughly 1,000 ft lower than the licensed area. It is also the closest NWS station to the project site. Available hourly data from Riverton span from November, 1996 to the January, 2012 and therefore represent slightly more than 15 years.

Figure 2.5-29 shows wind roses for Riverton AP. The wind rose on the left reflects 15 years of monitoring, while the one on the right reflects the Gas Hills site baseline monitoring period only. It can be seen that wind speeds and directions are very similar between the 15-year and one-year monitoring periods.

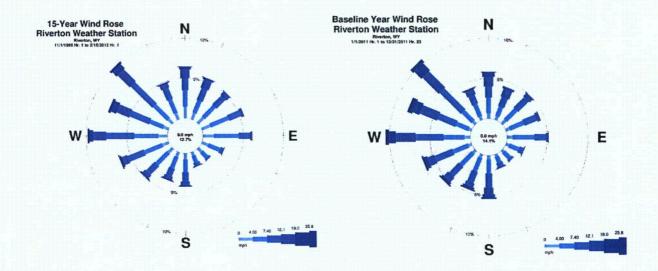
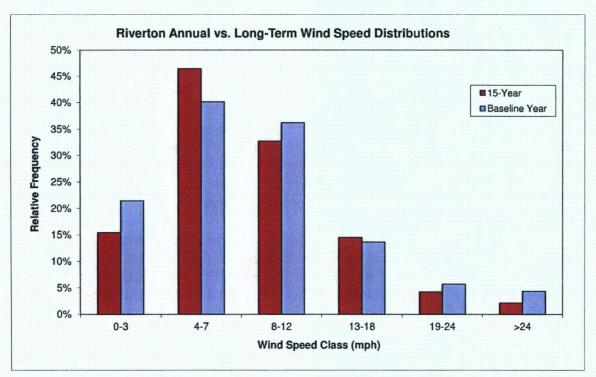


Figure 2.5-29. Riverton 15-Year vs Baseline Year Wind Roses.

Figure 2.5-30 compares the wind speed frequency distributions between the 15year and baseline periods at Riverton. The percent of the time the wind blows in each of the six wind speed categories shown, is quite similar for the two monitoring periods.

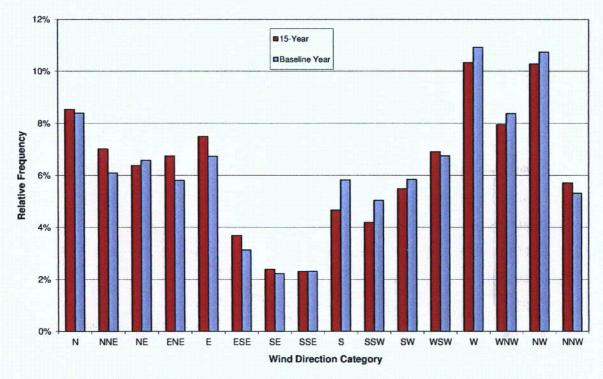


Source: National Climate Data Center, 2012, hourly data from 1996 through 2012

Figure 2.5-30. Riverton 15-Year vs Baseline Year Wind Speeds.

Figure 2.5-31 compares the wind direction frequency distributions of the 15-year and baseline periods at Riverton. The percent of the time the wind blows from each of the sixteen wind directions shown, is quite similar for the two monitoring periods.

Riverton Annual vs. Long Term Wind Direction Distributions



Source: National Climate Data Center, 2012, hourly data from 1996 through 2012

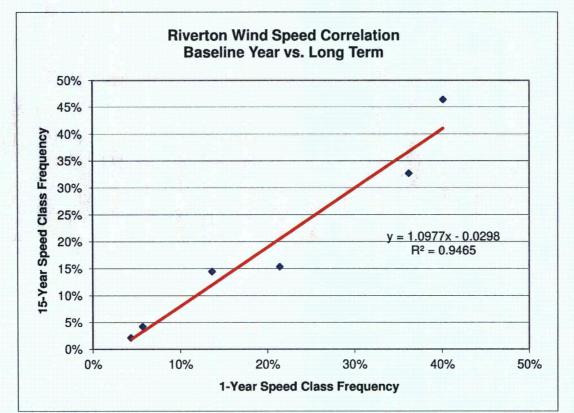
Figure 2.5-31. Riverton 15-Year vs Baseline Year Wind Speeds.

In order to quantify this similarity, it is useful to isolate wind speed and wind direction variables and to correlate short-term and long-term frequency distributions. This constitutes a statistical methodology for assessing the degree to which the distributions of wind speed class and wind direction frequencies from one year of monitoring at a particular location represent the long-term distributions at that same location.

For the joint frequency wind distribution used in the MILDOS-AREA model, wind speeds are divided into six classifications ranging from mild (0 - 3 mph) to strong (> 24 mph), as illustrated in Table 2.5-5 and Figure 2.5-30 above. Likewise, wind directions are divided into 16 categories corresponding to the compass directions illustrated in the wind roses presented above and in Figure 2.5-31.

The percent of the time that winds occur in each of the six wind speed categories can be calculated to produce a wind speed frequency distribution. The percent of the time that winds blow from each of the sixteen directions can be calculated to produce a wind direction frequency distribution. For each parameter, the one-year and 15-year distributions can then be compared. Linear regression analysis provides a useful tool to assess the degree of correlation between short and long-term distributions.

Figure 2.5-32 presents this correlation for the wind speed distributions at Riverton. Each point represents one of the six wind speed classes. The x coordinate corresponds to the percent of the one-year period during which the wind speed fell in a given class, while the y coordinate corresponds to the percent of the 15-year period during which the wind speed fell in that same class.



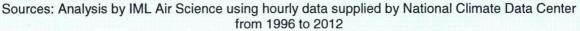


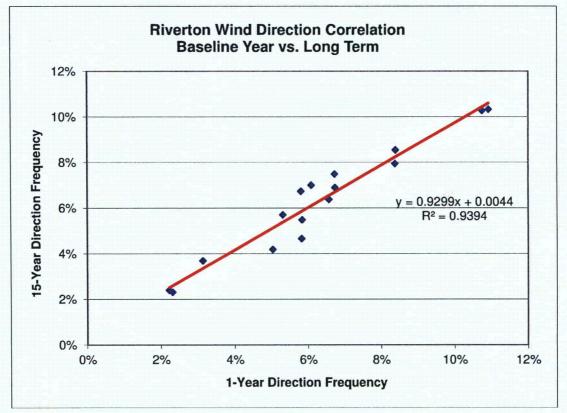
Figure 2.5-32. Riverton 15-Year vs Baseline Year Wind Speed Distributions.

The regression line (red) in Figure 2.5-32 represents the least-squares fit to the six data points. The corresponding R^2 value of 94.7% implies very strong linear correlation.

A similar analysis can be performed for wind direction frequencies. Figure 2.5-33 presents this correlation, again for the Riverton AP site. Each point represents one of the sixteen wind direction categories. The x coordinate corresponds to the percent of the one-year period during which the wind blew from a given direction, while the y coordinate corresponds to the percent of the 15-year period during which the wind blew from that same direction.

The regression line (red) in Figure 2.5-33 represents the least-squares fit to the sixteen data points. The corresponding R² value of 93.9% implies very strong

linear correlation. This correlation would likely be even stronger except for low resolution provided in the wind direction data from the Riverton AP site. The NWS records hourly average wind directions, or azimuth angles, to the nearest 10°. Given that each wind direction category spans only 22.5°, this coarse resolution compromises the correlation analysis between short and long-term wind directions.



Sources: Analysis by IML Air Science using hourly data supplied by National Climate Data Center from 1996 to 2012

Figure 2.5-33. Riverton 15-Yr vs Baseline Yr Wind Direction Distributions.

Despite this limitation, Figures 2.5-32 and 2.5-33 offer conclusive evidence that the 2011 baseline monitoring year adequately represents the last 15 years at Riverton.

The same argument can be made for the Casper site. Although 10 miles farther from the project site than Riverton, Casper has higher wind speeds that more closely match Gas Hills on-site wind speeds. Moreover, the dominant southwesterly winds at Casper resemble the prevailing south-southwesterly winds at Gas Hills. Figure 2.5-34 shows 8-year and baseline-year wind roses at Casper to be nearly identical. Figures 2.5-35 and 2.5-36 show the Casper wind speed and direction frequency correlations, respectively, between the baseline year of 2011 and the 8-year period for which data were obtained.

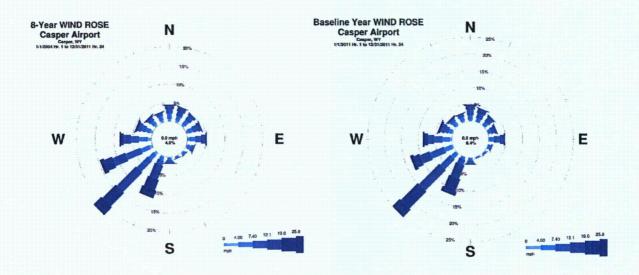
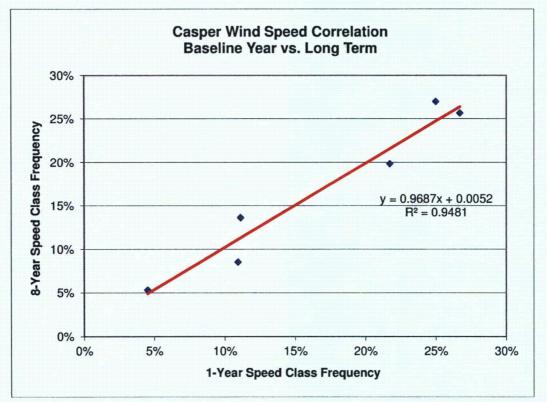
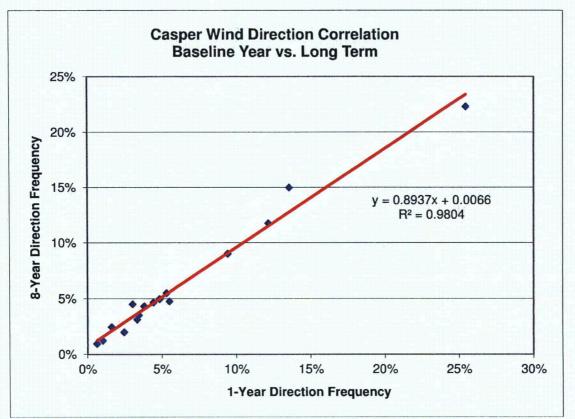


Figure 2.5-34. Casper 8-Yr vs Baseline Yr Wind Roses.



Sources: Analysis by IML Air Science using hourly data supplied by National Climate Data Center from 2004 to 2011

Figure 2.5-35. Casper 8-Yr vs Baseline Yr Wind Speed Distributions.



Sources: Analysis by IML Air Science using hourly data supplied by National Climate Data Center from 2004 to 2011

Figure 2.5-36. Casper 8-Yr vs Baseline Yr Wind Direction Distributions.

The R² values of 94.8% for wind speed and 98.0% for wind direction indicate even stronger correlation between the short and long term winds at Casper. Although the Casper long term data span only 8 years (vs. 15 for Riverton), a very strong linear correlation is evident.

Since the one-year wind data serve as reliable predictors of the long-term wind conditions at Riverton and Casper, and since the Gas Hills site experiences similar regional weather patterns, it is proposed here that the one-year baseline monitoring represents long-term meteorological conditions at the Gas Hills Remote Satellite site.

On-Site Meteorological Instrument Specifications

Table 2.5-15 lists the meteorological instruments employed at the Gas Hills meteorological monitoring station. The table shows instrument models, accuracy specifications, and instrument heights above the ground. Calibration records for the meteorological instruments are contained in Appendix A to this document.

Meteorological data collection, management and reporting methods at the project site conform to NRC atmospheric dispersion modeling requirements for uranium milling operations, and meet the acceptance criteria established in the NRC's NUREG-1569. The on-site monitoring program was developed according to NRC Regulatory Guide 3.63, "Onsite Meteorological Measurement Program For Uranium Recovery Facilities – Data Acquisition and Reporting." Hourly average values for wind speed, wind direction, sigma theta, temperature, relative humidity, precipitation and solar radiation are generated by field instruments and recorded by continuous data loggers. Data recovery exceeded 99% for the 13-month monitoring period. All hourly data have been downloaded to a relational database for quality assurance, statistical analysis and reporting purposes.

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Table 2.5-15. Gas Hills Monitoring Details

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Parameter	Measurement Method	Manufacturer and Model Number	Sampling Frequéncy	Averaging Period	Measurement Range	Instrument Reading Accuracy	Monitoring Height
Horiżontal Wind Speed	Frequency	RM Young 05305-AQ	1 second	Minute/Hourly	0 – 50 m/s	±0.2 m/s	10 meters
Wind Direction	Precision potentiometer	RM Young 05305-AQ	1 second	Minute/Hourly	0 - 360°	±3°	10 meters
Ambient Temperature	Thermistor	Met One 062	1 second	Minute/Hourly	-50° to +50° C	±0.05° C	10 meters
Ambient Temperature	Thermistor	Met One 062	1 second	Minute/Hourly	-50° to +50° C	÷ ±0.05° C	2 meters
Ambient Temperature	Thermistor	Vaisala HMP45C	1 second	Minute/Hourly	-45° to +60° C	±0.5° C	2 meters
Dew Point Temperature	Calculated	Calculated	Calculated	Minute/Hourly Calculated	N/A	N/A	2 meters
Differential Temperature	Calculated	Calculated	1 second	Minute/Hourly	N/A	N/A	2 -10 meters
Relative Humidity	Capacitive polymer H-chip	Vaisala HMP45C	1 second	Minute/Hourly	0.8% to 100%	±2% (0-90%RH) ±3% (90-100%RH)	2 meters
Solar Radiation	Silicon photovoltaic detector	Campbell LI200X	1 second	Minute/Hourly	0-2000 W/m ²	±5%	2 meters
Precipitation	Tipping Bucket	Texas Instruments TE525WS	Event Data	Minute/Hourly	Finite increments of tip of rainfall	±1%	75 cm

Source: Cameco Resources, 2012 .

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Upper Atmosphere Characterization

Mixing height is the height of the atmosphere above the ground that is well mixed due either to mechanical turbulence or convective turbulence. The air layer above this height is stable. Higher mixing heights are associated with greater dispersion, all other parameters being the same. Stable periods have much lower mixing heights and accompanying lapse rates allowing for less temperature variation. The MILDOS-AREA model uses mixing height, along with other wind parameters, to predict pollutant dispersion. Unstable air leads to more dispersion, which leads to lower predicted impacts on ambient air quality. The default mixing height used by MILDOS-AREA is 100 meters, a very conservative value.

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The nearest upper-air data available from the National Weather Service are from Lander, Wyoming, approximately 70 miles west of the site. Average mixing heights were derived from the AERMOD calculations used for dispersion modeling, based on hourly data obtained from the National Weather Service station in Lander (upper air). The AERMOD calculation is based on a combination of mechanically and convectively driven boundary layer processes. The results of these calculations are provided for morning and afternoon periods in Table 2.5-16. The 24-hour annual average mixing height is 916 meters.

Time Period (Filtered)	Average Mixing / Inversion Height
Morning (2 am - 7 am)	579 meters
Afternoon (2 pm – 7 pm)	1,123 mēters

Sources: IML computation based on data from National Climate Data Center, 2011

Table 2.5-16. Lander Mixing Heights.

The mixing or inversion heights are entered as inputs to the MILDOS-AREA model for pollutant dispersion modeling. For the Gas Hills Remote Satellite, the 1997 MILDOS modeling run used 400 meters for the morning mixing height and 2,400 meters for the afternoon mixing height.

Bodies of Water and Special Terrain Features

The nearest significant body of water to the proposed Gas Hills project is the Sweetwater River, approximately 20 miles south of the Gaas Hills Remote Satellite site. This is a relatively small tributary flowing into the North Platte River approximately 40 miles southeast of the site. It is highly unlikely that the influence of such a small stream could be measured 20 miles away with a standard humidity probe.

The nearest mountain ranges to the Gas Hills site are:

• the Rattlesnake Mountains, approximately 10 miles to the east

the southern extreme of the Bighorn Mountains, approximately 35 miles to • the north

It is believed that the Bighorn Mountains have little if any impact on meteorology at the site. The Rattlesnake Mountains rise to over 8,000 ft. in elevation and may block relatively uncommon easterly winds or redirect them to a more northeasterly direction (Figure 2.5-20). Since the prevailing winds in the region are southwesterly, the Rattlesnake Mountains exert only a peripheral impact on the dominant wind pattern, introducing a more southerly component to the southwesterly flow observed in other parts of the region. and the second second

The Beaver Rim is a prominent erosional escarpment extending from the Rattlesnake Mountains westward to the Wind River Mountains. Rising several hundred feet, it cuts through the southern portion of the Gas Hills site. It is likely that this geographic feature exerts some influence on local meteorology, especially differentiating wind patterns atop the rim from those below the rim.

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Conclusion

The Gas Hills Remote Satellite in west-central Wyoming is located in a semi-arid or steppe climate. The area is characterized by abundant sunshine, low relative humidity, and sustained winds which lead to high evaporative demand. The region has large diurnal and annual variations in temperature.

Five meteorological stations were used to characterize regional weather patterns. The region experiences average daily maximum temperatures near 80° in July and average daily minimum temperatures around 10° F in January. There are large diurnal and annual variations in temperature. The region has cold harsh winters, warm dry summers, and cool springs and autumns. Temperature extremes range from approximately -30° F in the winter to over 100° F in the summer. The on-site average temperature during the baseline monitoring year at Gas Hills was 42° F with extremes of -21° to +89° F. The region generally receives little precipitation with annual averages between 8 and 12 inches. Spring and early summer precipitation events are responsible for the majority of the yearly average.

The region is characterized by annual average wind speeds of 8 to 15 mph. Winds at the Gas Hills site are expected to average 14 mph annually, with summer averages dipping to near 10 mph and winter averages exceeding 16 mph. The predominant wind directions are from the south-southwest and southwest.

The Riverton AP And Casper AP meteorological stations were included in the site specific analysis to validate the temporal representativeness of on-site wind data by incorporating wind monitoring results from a longer period of record. The Riverton site is located 48 miles west-northwest of the Gas Hills site while the Casper site is 58 miles east of the Gas Hills site. The distributions of wind speeds and directions at Riverton during the baseline monitoring period have been shown to closely represent Riverton's 15-year distributions of wind speeds and directions. The same has been shown for Casper's 8-year distributions. The evidence strongly supports the assertion that winds during the baseline year of 2011 at the Gas Hills Remote Satellite site are representative of the long term.

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Appendix A

Gas Hills Meteorological Station Calibration

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north on 6/ measured	Test Input Deg. 358 88 178 268 58 58 58 58 58 58 58 58 58 58 58 58 58	Accura Output Deg 360 92 181 269 neasured at The accurac	cy Test Re Error Deg. 2 3 2 1 1 88.4 degre	ees to true		0.49 mps Test Input Deg 0 30 60 90 120 150 180 210 240 270 300	Pas Linear Output Deg 0 31 62 ; 93 122 151 180 209 239 268 298	ss? / Fail?: ity Test Res Nrmlzd* Deg. NA 1 1 1 1 1 -1 -1 -1 -1 -1 -1 -1 -1 -1 0	 ≤ 0.50 mps sponse Pass? Fail? NA PASS 	· · · · · ·
- The cross north on 6/ measured	Test Input Deg. 358 88 178 268 58 58 58 58 58 58 58 58 58 58 58 58 58	Accura Output Deg 360 92 181 269 neasured at The accurac	cy Test Re Error Deg. 2 3 2 1 1 88.4 degre	ees to true		0.49 mps Test Input Deg. 0 30 60 90 120 150 180 210 240 270 300 330 350	Pas Linear Output Deg. .0 .0 .0 .0 .0 .0 .0 .0 .0	ity Test Res Nrmlzd* Deg. NA 1 1 1 1 -1 -1 -1 -1 -1 -1 -1 -1 -1 0 1 2	 ≤ 0.50 mps sponse Pass? Fail? NA PASS 	· · · ·
- The cross north on 6/ measured	Test Input Deg. 358 88 178 268 Sarm was n /13/2011. against the nput Deg."	Accura Output Deg 360 92 181 269	cy Test Re Error Deg. 2 3 2 1 88.4 degre cy test resp This is ref	ees to true	, equal to	C. 0.49 mps Test Input Deg. 0 30 60 90 120 150 180 210 240 270 300 330 350 * Normal	Pas Linear Output Deg. .0 .0 .0 .0 .0 .0 .0 .0 .0	ity Test Res NrmIzd* Deg NA 1 1 1 1 -1 -1 -1 -1 -1 -1 -1 -1 0 1 2 degrees.	 ≤ 0.50 mps sponse Pass? Fail? NA PASS 	· · · · · · · · · · · · · · · · · · ·
- The cross north on 6/ measured	Test Input Deg. 358 88 178 268 Sarm was n /13/2011. against the nput Deg."	Accura Output Deg 360 92 181 269 neasured at The accurac	cy Test Re Error Deg. 2 3 2 1 88.4 degre cy test resp This is ref	ees to true	, equal to	C. 0.49 mps Test Input Deg. 0 30 60 90 120 150 180 210 240 270 300 330 350 * Normal	Pas Linear Output Deg. .0 .0 .1 .0 .0 .0 .0 .0 .0 .0 .0 .0 .0	ity Test Res NrmIzd* Deg. NA 1 1 1 -1 -1 -1 -1 -1 -1 -1 0 1 2 degrees. ≤ 0.50 mps	 ≤ 0.50 mps sponse Pass? Fail? NA PASS 	· · ·

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			PART A	: ANCI	ILLARY	INFORM	IATION		
Project:	Gas Hills			Date:	7/13/2011	٤: .		с	heck One:
Location:					13:00 7/13			As Found: _	<u> </u>
echnician:	Ethan Brov	vn <u>, ,</u>		End:	16:00 7/13	/2011	•	As Left:	
	M-4 0			<u>SENSO</u>	R INFORM	<u>IATION</u>	0.11.1		(12002 /0 -60)
	Met One		· · ·					–	(13983 (2 of 2) (13983 (1 of 2)
woael:	062 MP		<u> </u>						(13983 (1 of 2) 50 to +50 C
							operau	ng Nange	
			<u>CA</u>	LIBRATIC	<u>ON TEST I</u>	EQUIPME	<u>NT</u>		
Item:	Dostmann	Electronic (SmbH P65	D-PT			<u>```</u>	SN:	65010081147
Item:	Dostmann Insulated w	vater baths	with mecha	nical stirrin	ıg.	· • • • •		SN.	NA
I	Bath Ice Cool Hot	0.00 23.00 40.05	0.00 22.91 40.05	Error °C 0.00 -0.09 0.00	Fail? PASS PASS PASS	°C -0.02 22.87 40.05	Error °C -0.02 -0.13 0.00	Fail? PASS PASS PASS	
		ture Diffe	:	· ·		1	•		
	Tempera	· · · · · · · · · · · · · · · · · · ·							
	Tempera Known	Input	Obse	erved Resp	onse		(NOTE: T	he water bat	ns were constantly
	ļ	ΔT - [‡]	2-10 ∆T	2-10 ∆T	Pass?		agitated	with mechar	nical stirring during
	Known	∆T °C	2-10 ∆T _°C	2-10 ∆T Error ⁰C	Pass? ' Fail?		agitated		nical stirring during
	Known Water Bath Ice	∆T - °C	2-10 ∆T _°C 0.02	2-10 ∆T Error °C _0.02	Pass? Fail? PASS		agitated the calib	with mechar ration tests.)	nical stirring during
	Known Water Bath Ice Cool	ΔT - °C 0.00	2-10 ∆T °C 0.02 0.05	2-10 ∆T Er(or °C 0.02	Pass? Fail? PASS PASS		agitated the calib (NOTE: D	with mechar ration tests.) uring the ΔT	nical stirring during calibration, both
	Known Water Bath Ice	∆T - °C	2-10 ∆T _°C 0.02	2-10 ∆T Error °C _0.02	Pass? Fail? PASS		agitated the calib (NOTE: D probes w	with mechar ration tests.) uring the ΔT	nical stirring during calibration, both
	Known Water Bath Ice Cool	ΔT - °C 0.00	2-10 ∆T °C 0.02 0.05	2-10 ∆T Er(or °C 0.02 0.05) 0.00	Pass? Fail? PASS PASS		agitated the calib (NOTE: D	with mechar ration tests.) uring the ΔT	nical stirring during
	Known Water Bath Ice Cool	ΔT - °C	2-10 ∆T °C 0.02 0.05 0.00	2-10 ΔT Error °C 0.02 0.05 0.00	Pass? Fail? PASS PASS PASS	<u></u>	agitated the calib (NOTE: D probes w bath.)	with mechar ration tests.) uring the ΔT ere placed to	nical stirring during calibration, both
	Known Water Bath Ice Cool	ΔT - °C	2-10 ∆T °C 0.02 0.05 0.00	2-10 ∆T Er(or °C 0.02 0.05) 0.00	Pass? Fail? PASS PASS PASS	<u> </u>	agitated the calib (NOTE: D probes w bath.)	with mechar ration tests.) uring the ΔT	nical stirring during calibration, both
To PA	Known Water Bath Ice Cool Hot	∆T - (°C (0.00 (2-10 ∆T °C 0.02 0.05 0.00	2-10 ∆T Error °C 0.02 0.05 0.00	Pass? Fail? PASS PASS PASS	v error = ≤ ±	agitated the calib (NOTE: D probes w bath.)	with mechar ration tests.) uring the ΔT ere placed to r test point	nical stirring during calibration, both

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		PART /	A: ANC	ILLARY I	NFORM	IATION			
Project: Gas Hills			Date:	7/13/2011				Check One:	
Location: Wyoming			Start:	13:00 7/13/2	2011	/	As Found:	<u> </u>	
echnician: Ethan Brow	wn	1	End:	16:00 7/13/2	2011		As Left:	AL STREET	
			SENSO	R INFORM	ATION				
Make: LiCor		·	_			Operati	ng Range:	0 to 1,400 W/m	2
Model: 200 Pyran	ometer				He	eight Abov	e Ground:	1.8 meters	
SN: PY69340			-						-
		<u>C</u>		<u>ON TÉST E</u>	QUIPME	<u>N</u> T			
Item: Kipp & Zor									
Item: Fluke, Mo	<u>lel 289, digi</u>	ital multime	eter (4.5 dig	its, True RM	S)		SN:	96210097	<u> </u>
	P	PART B:	CALIB	RATION	TEST F	RESULTS	Ŝ	- • · · · · · · ·	
	Known	Input		Observe	d DAS Re	sponse	zoran zugatern		
;	Period	Value	DAS	Error	Error	Errőr	Pass?	2 2 2 2 2 2	
	hhmm	W/m ²	W/m ²	W/m ²	%	% F.S.	Fail? ⁴		
· ·	Covered	、0.0 。	<u>0</u>	0	NA ,	NA	PASS	• • •	
	1347	112	112	-1	-0.5	0.0	PASS		
	1456	181	176 1070	-5 36	-2.9 3.5	-0.4 2.6	PASS PASS		
	1435 14.42	1034 975	1070	35	3.5 3.6	2.5	PASS	• • • • · · · ·	
	1450	162	154	-8	-5.1	-0.6	FAIL	1	
	1454	210	203	-7	-3.2	-0.5	PASS		
								• •	
,	,	Colibra	tion Curve	Results ⇔	Slope: ¹	1.0435	PASS]	
		Calibrat			ntercept: ²	-9.412	PASS	1 ·	
					r. Coeff: ³	0.9999	PASS	1	
:.' /	· .							۰۰۰ - ال پ	
					2		_ ·	<u> </u>	· ·
			<u> </u>	COMMENTS	2				
; <u>.</u> ; <u>.</u>		ae of value	es due to inc	reasing clou	d cover th	roughout th	e day.		
- It was difficult to get	a large ran	ge of value							
- It was difficult to get	a large ran	ge of value						·· ·	
- It was difficult to get	a large ran			на страна 1947 — Солония 1947 — Солония		·		ana Santa Mérikana Santa Santa	

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PA	RT A: ANCILLARY INFORI	NATION	
Project: Gas Hills	Date: 7/13/2011	-	eck One:
Location: Wyoming	Start: <u>13:00 7/13/2011</u>	_ As Found:	
Technician: Ethan Brown	End: 16:00 7/13/2011	As Left:	
	SENSOR INFORMATION		
Make: Vaisala Model: HMP45AC		Operating Range: <u>0</u> leight Above Ground: 2	
SN: F3630128	<u></u> п		meters
	CALIBRATION TEST EQUIPME	ENT	
Item: Fisher Scientific Traceable	Hygrometer, Thermometer, Dew Point		102060060
PAR	TB: CALIBRATION TEST	RESULIS	·
	OBSERVED RESPONSE	7	
Test %	6RH %RH %RH Fail? ¹	-	
	30.8 27.8 -3.0 PASS		
Chmbr. 9	93.0 94.5 1.5 PASS	· · ·	
		··.	
·	<u>COMMENTS</u>		

	PART A:	ANCILLARY	INFORMAT	ION	
Project: <u>Gas Hills</u>		Date: 7/13/2011		C	neck One:
Location: Wyoming		Start: 13:00 7/13	/2011	As Found:	√
chnician: Ethan Brown		End: 16:00 7/13	2011	As Left: _	<u> </u>
	S		ATION		
Make: Met One			•	Gauge Type: <u>T</u>	ipping Bucket
Model: <u>TR525USW</u> SN: 45573-1010		Operating Range: NA Height Above Ground: 76.20 cm			
GN . <u>43373-1010</u>	i				0.20 4 0.11
		RATION TEST I			
Item: Distilled water, grad	luated cylinders, c	Irip device	· · · ·	SN: N	
· · · · · · · · · · · · · · · · · · ·	PART B: C	ALIBRATION	TEST RES	ULTS	
	···		· · ·		
			D RESPONSE		
ml, H ₂ C		DAS Error		iss? ill? ¹	
Land the second s		mm mm			
500	15.10 14	4.48 -0.62	<u>-4.1 P/</u>	ASS	
. ۵٬۰۵۰ - ۲۰۰۰ ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰	• •.			· · .	
		COMMENT	<u>s</u>		

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