






BSC

Technical Report Administrative Change Notice

 QA: QA
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Complete only applicable items.

1. Document Number: TDR-MGR-MM-000002	2. Revision: 00	3. ACN: 01
4. Title: Local Meteorology of Yucca Mountain, Nevada, 1994-2006		

5. Approvals:		
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6. Affected Pages	7. Reason for, and Description of Change:	
ix and B-5	Change dates for Table B-3: JFD, all hours at Site 2, from (1994 to 1998) to (1994 to 2006)	
8	Last paragraph, change reference from Section 4.2.1 to 4.2	
11	Table 2-2, change height of precipitation gauges to 1	
14	Table 2-4, change starting threshold speeds in calibration tolerance column to 0.45 m/sec (1.0 mph)	
50	Last line of third paragraph, change reference from Figure F-12 to F-16.	

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Site 401 (Bleach Bone Ridge)

Site 401 is on the northern end of the ridge on top of Yucca Mountain at an elevation of 1,563 m (5,129 ft) MSL. It is about 5.7 km northwest of Site 1, overlooking upper Yucca Wash (Figure 2-1 and Table 2-1). This is the highest elevation site in the network. The only measurement at Site 401 discussed in this report is the storage gauge measurement of precipitation.

Site 405 (Yucca Mtn–WX4b)

Site 405 is about the center of the ridge on top of Yucca Mountain at an elevation of 1,489 m (4,884 ft) MSL. It is about 2.2 km west-southwest of Site 1 (Figure 2-1 and Table 2-1). The only measurement at Site 405 is precipitation; only the storage-gauge data are discussed.

Site 415 (Yucca Mtn SE)

Site 415 is further south than Site 405 along the ridge top of Yucca Mountain, east of a small saddle separating the ridge top from the hill overlooking Abandoned Wash. It is at an elevation of 1,442 m (4,730 ft) MSL and is about 2.7 km southwest of Site 1 (Figure 2-1 and Table 2-1). The only measurement at Site 415 is precipitation; only the storage-gauge data are discussed.

2.3 LOCAL INSTRUMENT EXPOSURE

Early Atomic Energy Commission guidance provided in Regulatory Guide 1.23 [DIRS 103640], Section C.2-3, did not address local instrument exposure beyond the basic instrument height of 10 m AGL, with a second suitable level. Subsequent draft revisions and the final version of Regulatory Guide 1.23, Revision 1 [DIRS 181945], Section C.2-3, described three exposure factors for wind instruments: (1) the measurement heights should be 10 and 60 m AGL, (2) the instruments should be mounted a distance from the side of a tower at least two times the longest horizontal dimension of the tower, and (3) the tower should be a distance of at least ten times the height of an obstruction if the obstruction height exceeds one-half the height of the wind measurement.

Regulatory Guide 1.23, Revision 1 [DIRS 181945], Section C.2-3, for air temperature measurements include use of fan-aspirated radiation shields mounted with the inlet at least 1.5 times the horizontal width from the nearest point on the tower, at a height of 10 m AGL. For many years, the U.S. Environmental Protection Agency (EPA) meteorological monitoring guidance (EPA 2000 [DIRS 161842], Section 3.2.2) stated that air temperature is to be measured between about 1.25 and 2 m AGL. Since one meteorological monitoring program goal is to characterize the local climate, the primary temperature measurement height has been 2 m AGL since mid-1993. Using the 2 m AGL data, rather than data from 10 m AGL, is the single exception taken to the NRC monitoring guidance documents (BSC 2007a [DIRS 181944]).

Temperature data from the 10 and 60 m AGL heights at Site 1 were used to calculate vertical temperature difference as the indicator of atmospheric stability; see Section 4.2. The temperature data from the 10 m level at the remaining sites were taken for potential application in EPA modeling (EPA 2000 [DIRS 161842], Section 3.2.2) as indicators of atmospheric stability.

Table 2-2. Parameters Measured at Each Meteorological Monitoring Station^a (1994 to 2006)

Parameter	Height (m)	Site								
		1 (NTS-60)	2 (Yucca Crest)	3 ^b (Coyote Wash)	4 (Alice Hill)	5 ^b (Fortymile Wash)	6 ^b (WT-6)	7 ^b (Sever Wash)	8 ^b (Knothead Gap)	9 (Gate 510)
Wind speed	10	1994-2006	1994-2006	1994-1998	1994-2006	1994-1998	1994-1998	1994-1998	1994-1998	1994-2006
	60	1994-2006	—	—	—	—	—	—	—	—
Wind direction	10	1994-2006	1994-2006	1994-1998	1994-2006	1994-1998	1994-1998	1994-1998	1994-1998	1994-2006
	60	1994-2006	—	—	—	—	—	—	—	—
Vertical wind speed	10	1994-2006	1994-2006	1994-1998	1994-2006	1994-1998	1994-1998	1994-1998	1994-1998	1994-2006
Temperature	2	1994-2006	1994-2006	1994-2006	1994-2006	1994-2006	1994-2006	1994-2006	1994-2006	1994-2006
	10	1994-2006	1994-2006	1994-1998	1994-2006	1994-1998	1994-1998	1994-1998	1994-1998	1994-2006
	60	1994-2006	—	—	—	—	—	—	—	—
Vertical temperature difference	2 to 10	1994-2006	1994-2006	1994-1998	1994-2006	1994-1998	1994-1998	1994-1998	1994-1998	1994-2006
	10 to 60	1994-2006	—	—	—	—	—	—	—	—
Precipitation (tipping bucket)	1	1994-2006	1994-2006	1994-2006	1994-2006	1994-2006	1994-2006	1994-2006	1994-2006	1994-2006
Precipitation ^c (storage gauge)	1	1996-2006	1996-2006	1996-2006	1996-2006	1996-2006	1996-2006	1996-2006	1996-2006	1996-2006
Relative humidity	2	1999-2006 ^d	1994-2006	1994-2006	1994-2006	1994-2006	1994-2006	1994-2006	1994-2006	1994-2006
Dew-Point	2	1994-1998 ^d	—	—	—	—	—	—	—	—
Barometric pressure	2	1994-2006	1994-2006	1994-1998	1994-2006	1994-2006	1994-1998	1994-1998	1994-1998	1994-2006
Solar radiation	2	1994-2006	1994-2006	1994-1998	1994-2006	1994-1998	1994-1998	1994-1998	1994-1998	1994-2006

^a Blank cells indicate that the parameter was never measured at that site.

^b At Sites 3, 5, 6, 7, and 8, wind speed and direction, vertical wind speed, vertical temperature difference, barometric pressure, and solar radiation were recorded from 1994 to 1998, and discontinued in 1999, except barometric pressure continued to be recorded at Site 5.

^c Storage gauge precipitation measurements were started in October 1995.

^d Dew-point temperature was recorded from 1994 to 1998, and relative humidity was recorded from 1999 to 2006 at Site 1.

Table 2-4. System Accuracy Requirements

Measurement	Calibration Tolerance	Performance Check and Performance Audit Tolerance	Instrument Accuracy Requirement from NRC ^a	System Accuracy Requirement from NRC ^b
Wind Direction Starting threshold	± 3 degrees < 0.45 m/sec (1.0 mph) at 10 degrees	± 5 degrees Torque limits (gm-cm): Climatronics 100076: 6.0 Met One 1564B: 2.5	± 5 degrees	± 5 degrees < 0.45 m/sec (1 mph)
Wind Speed (horizontal and vertical) Starting threshold	< 5 m/s: ± 0.25 m/sec > 5 m/s: ± 5% of observed < 0.45 m/sec (1.0 mph)	Same accuracy as calibration; Torque limits (gm-cm): Climatronics 100075: 0.3 Met One 1565C: 0.25 Climatronics 102236: 0.75	± 0.5 mph < 1 mph	± 0.2 m/sec (± 0.45 mph) or 5% of observed wind speed < 0.45 m/sec (1 mph)
Temperature	± 0.5°C	± 0.5°C	± 0.5°C	± 0.5°C (± 0.9°F)
Vertical temperature difference	± 0.1°C (relative)	± 0.1°C (relative)	± 0.1°C	± 0.1°C (± 0.18°F)
Precipitation Recording gauge Manual storage gauge	Orifice: 8 ± 0.75 in. diameter Volume: ± 10%, Count: exact	Recording: same as calibration Manual: NA	None specified	± 10% for a volume equivalent to 2.54 mm (0.1 in.) of precipitation at a rate < 50 mm/h (< 2 in./hr)
Barometric pressure	± 3 millibars	± 3 millibars	None specified	None specified
Relative humidity	< ± 1.5°C dew point	RH ≤ 40%: ± 4% RH > 40%: see calibration	None specified	± 4%
Solar radiation Zero check Measurement	± 10 W/m ² ± 5%	Zero check; same as calibration	None specified	None specified

^a Regulatory Guide 1.23 [DIRS 103640]^b Regulatory Guide 1.23 [DIRS 181945], Revision 1

NA = not applicable; RH = relative humidity.

On the other hand, winds during the nocturnal hours were from northerly directions, with greater indications of direction channeling by terrain than was evident in the diurnal periods. These patterns are typical of “drainage” winds that occur in valleys with clear sky conditions at night. Winds at the 10 m level at Site 1 were from the W-N quadrant during 74% of the nocturnal hours; most of these winds were from the NW-NNW directions from 1.6 to 4.1 m/sec (Table C-2 and Figure F-2). Virtually all of the winds at Site 1 at the 10 m level during the most stable periods (categories F and G) were from the NW and NNW directions with speeds between 1.6 and 3.1 m/sec (Tables D-11 and D-13; Figures G-11 and G-13). This direction is aligned with the Drill Hole Wash feature on the east side of Yucca Mountain.

In a similar pattern but more exaggerated way, the nocturnal winds were from the W-NW directions for 73% of the time at Site 3 in Coyote Wash on the east side of Yucca Mountain; 47% of the time nocturnal winds were from the WNW, and the majority of those winds were in the 1.6 to 3.1 m/sec speed categories (Table C-8 and Figure F-8). Nocturnal drainage winds occurred at Site 7, which is near the Sever Wash hydrologic outflow feature of Midway Valley. Winds were from the W-NNW drainage direction at speeds below 3.1 m/sec during 64% of the hours. A related grouping of stronger winds with a more northerly component was seen with 13% of the nocturnal hours having speeds above 3.1 m/sec from the NNW-N directions (Table C-14 and Figure F-14).

Beyond Midway Valley, winds in the Jackass Flats area showed larger-scale down valley airflow characteristics. Winds at Site 5, which is along Fortymile Wash, were from the N-NNE with speeds 2.1 to 8.1 m/sec during 64% of the nocturnal hours (Figure F-12 and Table C-12). Finally, the winds at Site 9 on the southern boundary of the NTS near the Town of Amargosa Valley, were from the N-NNE during 63% of the nocturnal hours with speeds below 6.1 m/sec (Figure F-16 and Table C-16).

While similar to previous distributions discussed, nocturnal data from the ridge and hill tops (Sites 2 and 4) and the 60 m level at Site 1 showed another significant feature of dispersion conditions in the vicinity of Yucca Mountain. The stable atmospheric structure that occurs at night allows for winds at the 10 m level to be quite different from winds at higher levels. Winds at the Site 1 60 m level were from the NW-NE quadrant during 60% of the time, generally with speeds less than 3.1 m/sec, though the N directions showed relatively frequent occurrences of winds up to 8.1 m/sec (Figure F-4 and Table C-4). These directions are related to the overall features of Midway Valley, rather than the specific terrain feature, Drill Hole Wash, that appears to influence winds at the 10 m level at Site 1 (Figure F-2). The winds at the 60 m level with category G stability were mostly from the NNW-N directions, with speeds less than 3.1 m/sec (Figure G-14 and Table D-14). The winds during category F stability were shifted to include the NNW-NNE directions, with some speeds from 3.1 to 8.1 m/sec (Figure G-12 and Table D-12).

In a similar way to the Site 1 winds at the 60 m level, winds at Site 4 on Alice Hill were from the NNW-NE directions during 70% of the nocturnal hours (Figure F-10 and Table C-10). As evidence of terrain features affecting the nocturnal winds in a different way, winds at Site 2 were from the NE-SSE directions for over 60% of the nocturnal hours (Figure F-6 and Table C-6). These directions tend to show large-scale airflow from the higher terrain well northeast of Yucca Mountain, as well as periods with southerly winds that are not affected by the local terrain influences at time.

Table B-3. Joint Frequency Distribution of Wind Speed and Direction (Decimal Fractions) for All Hours (1994 to 2006) at Site 2 at 10 m AGL

Wind Direction		Wind Speed Category (meters per second)										
Degrees Azimuth	Name	0.5 - 1.1	1.1 - 1.6	1.6 - 2.1	2.1 - 3.1	3.1 - 4.1	4.1 - 5.1	5.1 - 6.1	6.1 - 8.1	8.1 - 10.0	>= 10.0	Total
348.75 - 11.25	North	0.0003	0.0009	0.0014	0.0027	0.0032	0.0042	0.0043	0.0059	0.0031	0.0014	0.0275
11.25 - 33.75	North-Northeast	0.0004	0.0010	0.0018	0.0042	0.0051	0.0054	0.0051	0.0060	0.0022	0.0012	0.0323
33.75 - 56.25	Northeast	0.0005	0.0016	0.0028	0.0065	0.0104	0.0111	0.0072	0.0075	0.0020	0.0007	0.0505
56.25 - 78.75	East-Northeast	0.0005	0.0032	0.0068	0.0182	0.0172	0.0082	0.0035	0.0032	0.0009	0.0004	0.0622
78.75 - 101.25	East	0.0009	0.0048	0.0132	0.0366	0.0333	0.0119	0.0036	0.0018	0.0006	0.0003	0.1071
101.25 - 123.75	East-Southeast	0.0009	0.0044	0.0117	0.0321	0.0291	0.0154	0.0065	0.0023	0.0003	0.0001	0.1029
123.75 - 146.25	Southeast	0.0009	0.0044	0.0103	0.0248	0.0258	0.0182	0.0104	0.0080	0.0015	0.0002	0.1044
146.25 - 168.75	South-Southeast	0.0008	0.0039	0.0074	0.0159	0.0186	0.0195	0.0166	0.0215	0.0085	0.0020	0.1146
168.75 - 191.25	South	0.0010	0.0038	0.0066	0.0114	0.0115	0.0134	0.0115	0.0102	0.0023	0.0005	0.0722
191.25 - 213.75	South-Southwest	0.0012	0.0039	0.0066	0.0104	0.0088	0.0097	0.0069	0.0050	0.0013	0.0008	0.0546
213.75 - 236.25	Southwest	0.0017	0.0056	0.0081	0.0113	0.0130	0.0139	0.0102	0.0069	0.0019	0.0012	0.0738
236.25 - 258.75	West-Southwest	0.0017	0.0053	0.0069	0.0095	0.0077	0.0078	0.0075	0.0107	0.0037	0.0019	0.0626
258.75 - 281.25	West	0.0016	0.0043	0.0054	0.0076	0.0048	0.0036	0.0033	0.0045	0.0023	0.0011	0.0385
281.25 - 303.75	West-Northwest	0.0008	0.0022	0.0029	0.0036	0.0023	0.0020	0.0023	0.0032	0.0023	0.0029	0.0247
303.75 - 326.25	Northwest	0.0006	0.0013	0.0018	0.0026	0.0025	0.0025	0.0031	0.0064	0.0057	0.0146	0.0413
326.25 - 348.75	North-Northwest	0.0004	0.0009	0.0012	0.0022	0.0025	0.0032	0.0033	0.0057	0.0048	0.0065	0.0307
—	Total:	0.0144	0.0515	0.0950	0.1994	0.1959	0.1501	0.1056	0.1089	0.0433	0.0358	0.9972
											Calms:	0.00003
											Missing/Incomplete	0.00276
											Frequency of Calm Winds	0.00%
											Average Wind Speed	4.39 m/sec

Source DTN: MO0708MD9406JF.000 [DIRS 182587].

NOTE: Wind speeds are equal to the lower limit and are less than the upper limit.