7.1 Climate and Meteorology

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Meteorological measurements are taken to support Hanford Site emergency preparedness and response, operations, and atmospheric dispersion calculations for dose assessments (Appendix E, Tables E.5 and E.7 through E.9). Support is provided through weather forecasting and maintaining and distributing climatological data. Forecasting is provided to help manage weather-dependent operations. Climatological data are provided to help plan weather-dependent activities and are used as a resource to assess the environmental effects of site operations.

The Hanford Meteorology Station relies on data provided by the Hanford Meteorological Monitoring Network. This network consists of 30 remote monitoring stations that transmit data to the Hanford Meteorology Station via radio telemetry every 15 minutes. There are twenty-seven 9-meter (30-foot) towers and three 61-meter (200-foot) towers. Meteorological information collected at these stations includes wind speed, wind direction, temperature, precipitation, atmospheric pressure, and relative humidity; however, not all of these data are collected at all stations. Figure 7.1.1 shows the 2003 wind roses (i.e., diagrams showing direction and frequencies of wind) measured at a height of 9 meters (30 feet) for the 30 meteorological monitoring stations on and around the Hanford Site.

The Cascade Range, beyond Yakima to the west, greatly influences the climate of the Hanford Site because of its rain shadow effect. The regional temperatures, precipitation, and winds are affected also by the presence of mountain barriers. The Rocky Mountains and ranges in southern British Columbia protect the inland basin from severe, cold polar air masses moving southward across Canada and winter storms associated with them.

Real-time and historical data from the Hanford Meteorology Station can be obtained at http://terrassa.pnl.gov:2080/HMS/. Data on this web site include hourly weather observations, 15-minute data from the Hanford Meteorological Monitoring Network, monthly climatological summaries, and historical data.

The Hanford Meteorology Station is located on the Hanford Site's Central Plateau, where the prevailing wind direction is from the northwest during all months of the year. The secondary wind direction is from the southwest. Summaries of wind directions indicate that winds from the northwestern quadrant occur most often during winter and summer. During spring and fall, the frequency of southwesterly winds increases, with a corresponding decrease in the northwesterly flow. Monthly average wind speeds are lowest during winter months, averaging about 3 meters per second (6 to 7 miles per hour), and highest during summer, averaging about 4 meters per second (8 to 9 miles per hour). Wind speeds that are well above average are usually associated with southwesterly winds. However, summertime drainage winds are generally northwesterly and frequently exceed 13 meters per second (30 miles per hour). These winds are most prevalent over the northern portion of the site.

Atmospheric dispersion is a function of wind speed, wind duration and direction, atmospheric stability, and mixing depth. Dispersion conditions are generally good if winds are moderate to strong, the atmosphere is of neutral or unstable stratification, and there is a deep mixing layer. Good dispersion conditions associated with neutral and unstable stratification exist approximately 57% of the time during summer. Less favorable conditions may occur when wind speed is light, and the mixing layer is shallow. These conditions are most common during winter, when moderate to extremely stable stratification exists approximately 66% of the time. Occasionally, there are extended periods of poor dispersion conditions, primarily during winter, that are associated with stagnant air in stationary high-pressure systems.

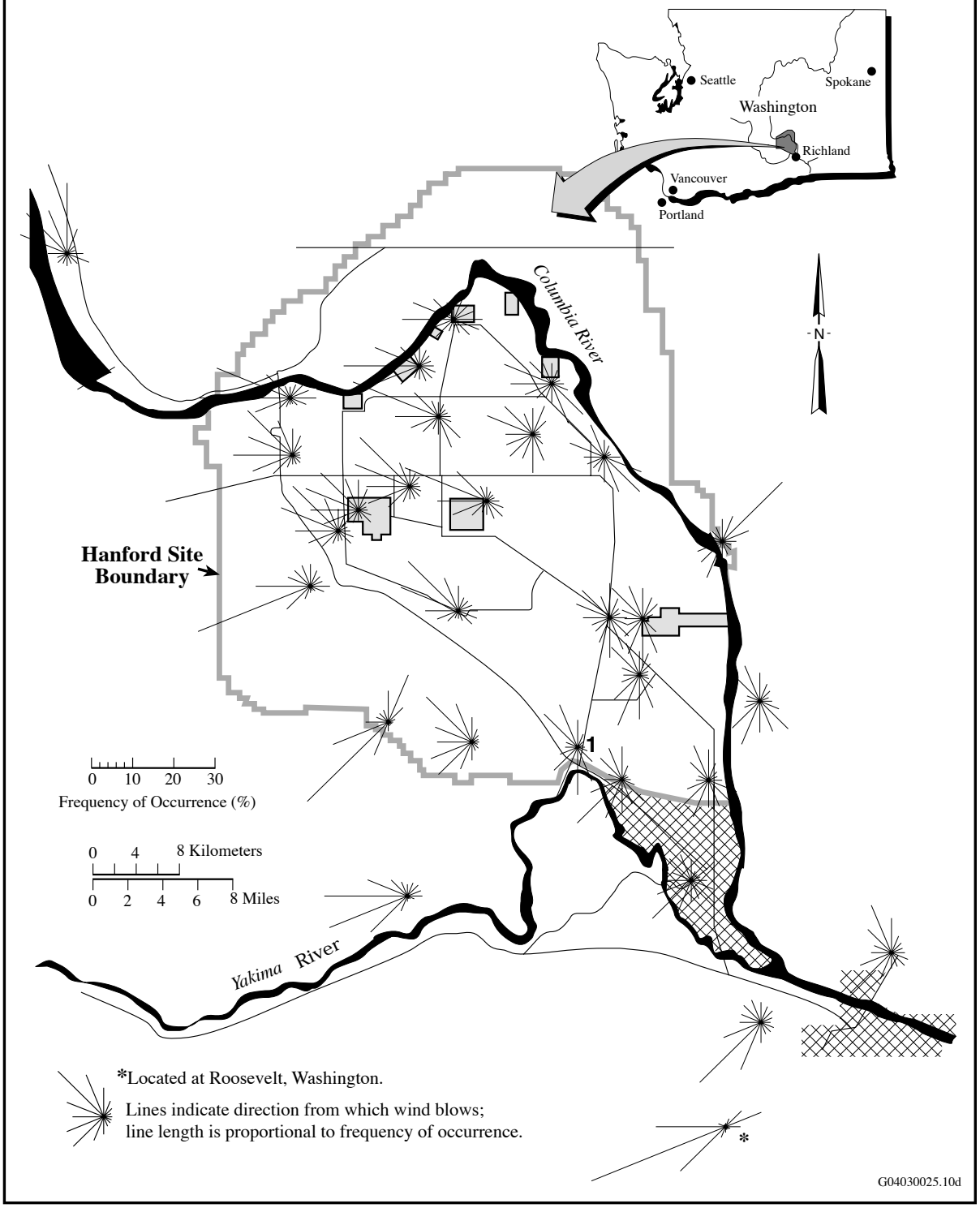

Figure 7.1.1. Hanford Meteorological Monitoring Network Wind Roses, 2003 (measured at a height of 9 meters [30 feet])

7.1.1 Historical Climatological Information

Daily and monthly averages and extremes of temperature, dew point temperature, and relative humidity for 1945 through 2003 are reported in PNNL-14616. From 1945 through 2003, the record maximum temperature was 45°C (113°F) recorded during August 1961 and July 2002, and the record minimum temperature was -30.6°C (-23°F) in February 1950. Normal monthly average temperatures ranged from a low of -0.2°C (31.7°F) in December to a high of 24.6°C (76.3°F) in July. During winter, the highest monthly average temperature at the Hanford Meteorology Station was 6.9°C (44.5°F) in February 1991, and the record lowest was -11.1°C (12.1°F) in January 1950. During summer, the record maximum monthly average temperature was 27.9°C (82.2°F) in July 1985, and the record minimum was 17.2°C (63.0°F) in June 1953. The normal annual relative humidity at the Hanford Meteorology Station is 54%. Humidity is highest during winter, averaging approximately 76%, and lowest during summer, averaging approximately 36%. Normal annual precipitation at the Hanford Meteorology Station is 17.7 centimeters (6.98 inches). The wettest year on record, 1995, received 31 centimeters (12.31 inches) of precipitation; the driest, 1976, received 8 centimeters (2.99 inches). Most precipitation occurs during late autumn and winter, with more than half of the annual amount occurring from November through February. The snowiest winter on record, 1992-1993, received 142.5 centimeters (56.1 inches) of snow.

7.1.2 Results of 2003 Monitoring

Calendar year 2003 was slightly warmer than normal and precipitation was above normal.

The average temperature for 2003 was 13.1°C (55.6°F), which was 1.1°C (2.0°F) above normal (12.0°C [53.6°F]). Nine months during 2003 were warmer than normal; three months were cooler than normal. January had the greatest positive departure, 3.4°C (6.2°F); and November, at 1.3°C (2.3°F) below normal, had the greatest negative departure.

Precipitation during 2003 totaled 20.7 centimeters (8.14 inches), 117% of normal (17.7 centimeters [6.98 inches]). Snowfall for 2003 totaled 22.1 centimeters (8.7 inches) (compared to an annual normal snowfall of 39.1 centimeters [15.4 inches]).

The average wind speed during 2003 was 3.5 meters per second (7.8 miles per hour), which was 0.1 meter per second (0.2 mile per hour) above normal. The peak gust for the year was 26.8 meters per second (60 miles per hour) on October 28.

There were two dust storms recorded at the Hanford Meteorology Station during 2003 (March 5 and October 28). There has been an average of five dust storms per year at the Hanford Meteorology Station during the entire period of record (1945-2003).

Table 7.1.1 provides monthly and annual climatological data collected at the Hanford Meteorology Station during 2003.

Table 7.1.1. Monthly and Annual Climatological Data from the Hanford Meteorology Station, 2003

Hanford Meteorology Station, 40 kilometers (25 miles) northwest of Richland, Washington, latitude 46° 34'N, longitude 119° 35'W, elevation 223 meters (733 feet)

Month	Temperatures, °C								Precipitation (cm)				Relative Humidity (%)		15-m Wind[a]				
	Averages				Extremes						Snowfall						Peak Gusts		
	Daily Maximum	Daily Minimum	Monthly	Departure[b]	Highest	Date	Lowest	Date	Total	Departure[b]	Total	Departure[b]	Average	Departure[b]	Average Speed, m/s	Departure[b]	Speed, m/s	Direction	Date
J	6.2	0.4	3.3	+3.4	19.4	26	-5.6	10	4.8	+2.5	1.8	-8.9	86.5	+9.2	2.3	-0.5	17.4	S	2
F	10.2	-1.3	4.4	+1.1	16.7	21	-9.4	25	2.1	+0.4	0	-6.6	66.3	-4.2	3.2	0	23.2	SW	20
M	15.9	3.0	9.4	+1.6	25.0	30	-2.8	24[c]	0.7	-0.8	0	-1.0	55.6	-1.0	4.2	+0.6	23.7	W	5
A	17.9	4.5	11.2	-0.7	25.6	8	-4.4	4	5.7	+4.5	0	- T[d]	55.5	-8.2	3.5	-0.5	21.4	SW	9
M	23.6	8.8	16.2	-0.4	33.9	28	1.1	19	0.2	-1.2	0	0	44.4	+1.4	3.7	-0.3	18.3	W	14
J	30.9	14.1	22.5	+1.8	37.8	28	7.2	21	T[d]	-1.0	0	0	33.3	-6.3	4.1	0	20.1	WNW	18
J	36.3	17.3	26.8	+2.2	42.2	30[c]	11.1	9	0	-0.7	0	0	28.4	-5.0	3.8	-0.1	18.3	WSW	12
A	33.4	15.9	24.7	+0.6	40.0	1	11.7	24	1.2	+0.5	0	0	36.6	+1.0	3.4	-0.2	20.1	WNW	19
S	29.1	12.2	20.7	+1.8	38.9	4	5.0	14	0.6	-0.2	0	0	38.8	-3.5	3.3	0	19.7	WNW	12
O	21.7	6.6	14.1	+2.4	31.2	21	-7.9	31	0.2	-1.1	0	-0.3	49.1	-7.3	3.8	+0.9	26.8	SW	28
N	9.1	-2.7	3.2	-1.3	20.0	18	-10.6	22	0.4	-2.1	T[d]	-5.8	62.9	-10.8	4.4	+1.5	24.1	SW	18
D	3.7	-2.7	0.5	+0.7	10.6	6	-13.3	30	5.0	+2.2	20.3	+5.6	87.0	+6.9	2.5	-0.2	16.1	SSW	6
Y[e]	19.8	6.3	13.1	+1.1	42.2	Jul 30[c]	-13.3	Dec 3	20.7	+2.9	22.1	-17.0	53.7	-0.9	3.5	+0.1	26.8	SW	Oct 28

NOTE: See Appendix A, Table A.2 in this report for unit conversion information.

(a) Measured on a tower 15 meters (50 feet) above the ground.

(b) Departu

(c) Latest of several occurrences.

(d) Trace.

(e) Yearly averages, extremes, and totals.