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 D, Tables D.5 and D.7 through D.9). Support is provided through weather forecasting and maintenance and distribution of 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.

Local data to support the Hanford Meteorology Station operations are provided via 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 parameters collected at these stations include wind speed, wind direction, temperature, precipitation, atmospheric pressure, and relative humidity; however, not all parameters are collected at all stations. Figure 7.1.1 shows the wind roses (diagrams showing direction and frequencies of wind) measured at a height of 9 meters (30 feet) for the network.

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

The Hanford Meteorology Station is located on the 200 Areas 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 direction indicate that winds from the northwest 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 10 to 11 kilometers per hour (6 to 7 miles per hour), and highest during summer, averaging 13 to 15 kilometers per hour (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 reach 50 kilometers per hour (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 moderately to extremely stable stratification exists ~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.

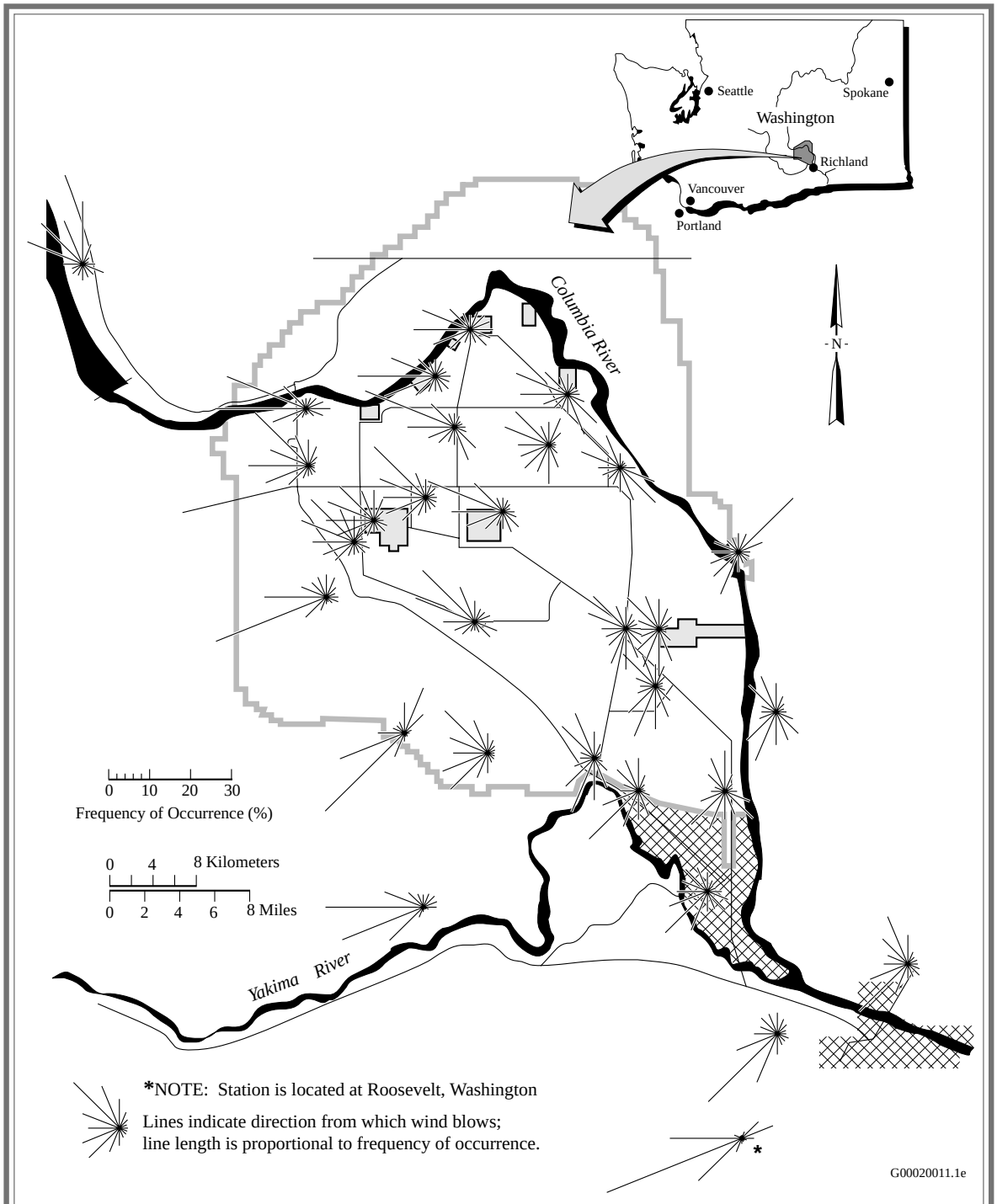

Figure 7.1.1. Hanford Meteorological Monitoring Network Wind Roses (measured at a height of 9 meters [30 feet]), 1999. Individual lines indicate direction from which wind blows.

7.1.1 Historical Information

Daily and monthly averages and extremes of temperature, dew point temperature, and relative humidity for 1945 through 1999 are reported in PNNL-13117. From 1945 through 1999, the record maximum temperature was 45° Celsius (113° Fahrenheit) recorded in August 1961, and the record minimum temperature was -30.6° Celsius (-23° Fahrenheit) in February 1950. Normal monthly average temperatures ranged from a low of -0.4° Celsius (31.3° Fahrenheit) in January to a high of 24.6° Celsius (76.2° Fahrenheit) in July. During winter, the highest monthly average temperature at the Hanford Meteorology Station was 6.9° Celsius (44.5° Fahrenheit) in February 1991, and the record lowest was -11.1° Celsius (12.1° Fahrenheit) in January 1950. During summer, the record maximum monthly average temperature was 27.9° Celsius (82.2° Fahrenheit) in July 1985, and the record minimum was 17.2° Celsius (63.0° Fahrenheit) in June 1953. The average annual relative humidity at the Hanford Meteorology Station is 54%. Humidity is highest during winter, averaging ~76%, and lowest during summer, averaging ~36%. Average annual precipitation at the Hanford Meteorology Station is 15.9 centimeters (6.26 inches). The wettest year on record, 1995, received 31 centimeters (12.3 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 1999 Monitoring

1999 was slightly warmer than normal and precipitation was much below normal.

The average temperature for 1999 was 12.4° Celsius (54.4° Fahrenheit), which was 0.6° Celsius (1.1° Fahrenheit) above normal (11.8° Celsius [53.3° Fahrenheit]). Six months during 1999 were warmer than normal, and six months were cooler than normal. January had the greatest positive departure, 3.9° Celsius (7.0° Fahrenheit); and May, at 1.9° Celsius (3.4° Fahrenheit) below normal, had the greatest negative departure. The maximum temperature of 17.8° Celsius (64° Fahrenheit) on August 31, 1999 was the coldest maximum temperature ever recorded during the month of August; and the maximum temperature of 24.4° Celsius (74° Fahrenheit) on November 13, 1999 was the warmest maximum temperature ever recorded during the month of November.

Precipitation for 1999 totaled 9.6 centimeters (3.75 inches), 60% of normal (15.9 centimeters [6.26 inches]) and was the fourth driest year on record. In addition, only 1.5 centimeters (0.6 inch) of snow were recorded (compared to an annual normal snowfall of 35.1 centimeters [13.8 inches]). The month of September received no precipitation whatsoever.

1999 was the windiest year on record, with an average wind speed of 14.2 kilometers per hour (8.8 miles per hour), which was 1.8 kilometers per hour (1.1 miles per hour) above normal. The peak gust for the year was 105 kilometers per hour (65 miles per hour) on February 6. February 1999 tied April 1972 as the windiest month on record, averaging 17.9 kilometers per hour (11.1 miles per hour). 1999 established a new record for days with wind gusts greater than 40 kilometers per hour (25 miles per hour) with 192; the previous record was 190 such days in 1953. Figure 7.1.1 shows the 1999 wind roses (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. There was

one dust storm recorded at the Hanford Meteorology Station during 1999. It occurred on February 2. There have been an average of five dust storms per year at the Hanford Meteorology Station during the entire period of record (1945-1999).

Table 7.1.1 provides monthly and annual climatological data from the Hanford Meteorology Station for 1999.

Table 7.1.1. Monthly Climatological Data from the Hanford Meteorology Station, 1999

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 Maximum	Monthly	Departure[b]	Highest	Date	Lowest	Date	Total	Departure[b]	Total	Departure[b]	Average	Departure[b]	Average Speed, km/h	Departure[b]	Speed, km/h	Direction	Date
J	8.1	-1.1	3.5	+3.9	16.7	14	-7.8	3	2.3	+0.2	T[c]	-9.9	74.0	-2.4	12.4	+1.9	88	S	29
F	10.4	0.4	5.4	+2.1	16.7	24	-6.7	11	1.8	+0.2	T	-5.1	61.5	-8.8	17.9	+6.3	105	SSW	6
M	14.1	1.8	7.9	+0.4	23.9	20	-3.9	2	0.2	-1.0	0	-0.8	52.8	-3.1	15.0	+1.6	84	SW	29
A	18.6	2.4	10.5	-1.0	27.8	24	-3.9	10	T	-1.0	0	- T	43.7	-3.5	14.2	-0.3	64	NW	2
M	22.1	6.6	14.4	-1.9	36.1	24	-1.1	8	0.9	-0.4	0	0	41.0	-1.7	16.7	+2.1	72	WNW	25
J	27.4	11.9	19.7	-1.3	38.9	15	3.3	6	0.8	-0.2	0	0	39.8	+1.0	15.6	+0.8	68	W	8
J	31.6	14.8	23.2	-1.3	40.6	28	7.2	3	0.2	-0.3	0	0	34.2	+0.7	15.1	+1.0	71	NW	24
A	32.6	16.5	24.6	+0.6	38.3	2	6.1	31	1.4	+0.8	0	0	40.9	+5.1	13.2	+0.5	71	NW	29
S	27.4	9.2	18.3	-0.4	32.8	22[d]	2.2	28	0	-0.8	0	0	36.3	-6.7	12.4	+0.5	69	WSW	25
O	18.2	3.9	11.0	-0.6	27.2	13	-2.8	27	1.2	+0.2	0	-0.2	49.4	-5.8	12.4	+1.9	74	W	31
N	12.6	2.7	7.7	+3.1	24.4	13	-3.3	3	0.7	-1.7	0	-4.6	72.2	-1.2	12.1	+1.8	66	SW	8
D	6.9	-0.6	3.2	+3.5	16.7	16	-6.7	8	0.2	-2.4	1.5	-13.0	75.4	-4.9	12.1	+2.6	100	WSW	18
Y[e]	19.2	5.7	12.4	+0.6	40.6	Jul 28	-7.8	Jan 3	9.6	-6.4	1.5	-33.6	51.8	-2.5	14.2	+1.8	105	SSW	Feb 6

NOTE: See Table H.2, Conversion Table in "Helpful Information" for unit conversion information.
(a) Measured on a tower 15 meters (50 feet) above the ground.
(b) Departure columns indicate positive or negative departure of meteorological parameters from 30-year (1961-1990) climatological normals.
(c) Trace.
(d) Latest of several occurrences.
(e) Yearly averages, extremes, and totals.