

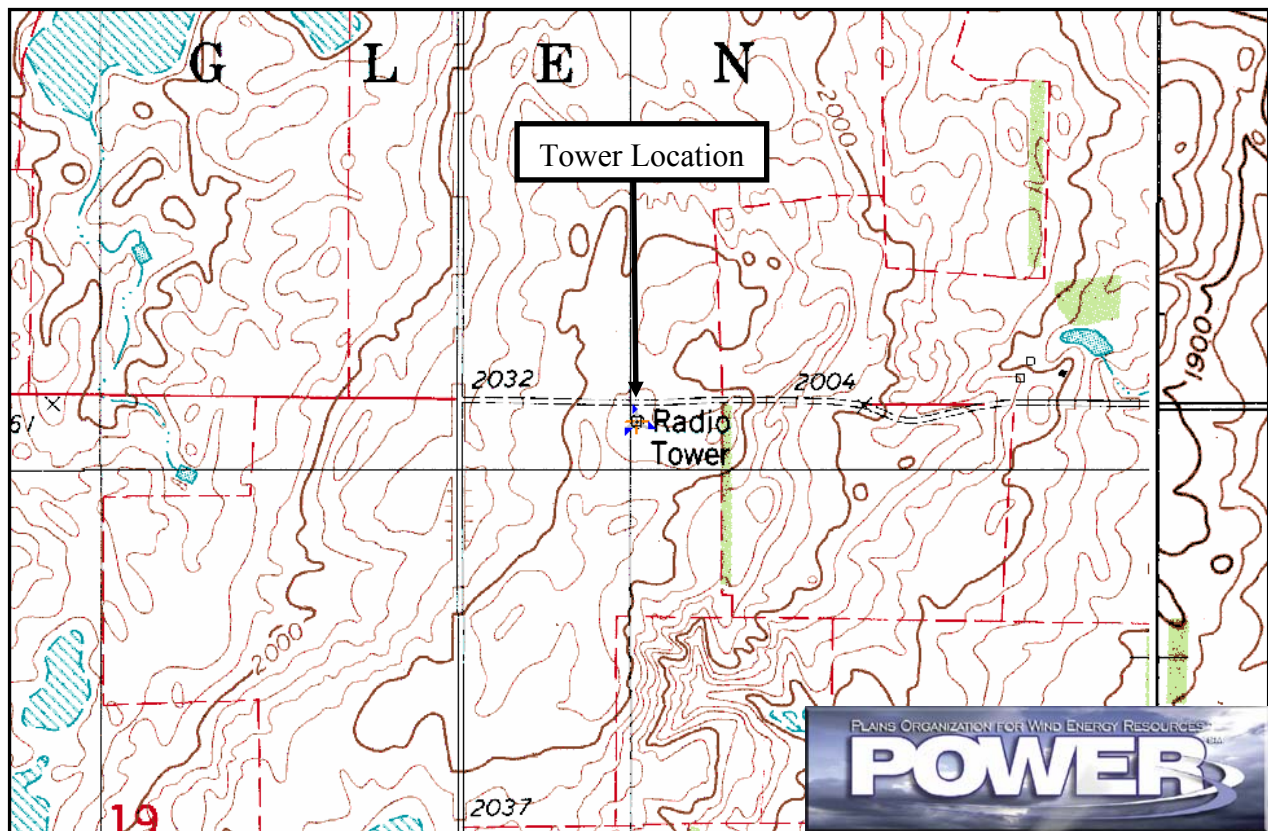
Wind Resource Summary for Alfred Site

North Dakota Utility Study
 Springs^a 1995, 1996 & 1997

Site Description:

Latitude: N 46° 35' 14"	Township: 136 N
Longitude: W 99° 0' 48"	Range: 66 W
Elevation: 2070 feet	Section: 20
Tower Type: Lattice Tower	Tower Height: 160 feet

The monitoring site was 6.7 miles southeast of the town of Gackle, North Dakota. An existing tower was used and instrumented at three levels: 33 ft (10 m), 82 ft (25 m), and 131 ft (40 m). The tower was located on a ridge with good wind exposure; however, an 1100-ft long, north-to-south windbreak was located 530 ft east of the tower.



Summary Wind Data:	33 ft AGL ^b	82 ft AGL	131 ft AGL
Mean Wind Speed	14.8 mph	17.4 mph	18.1 mph
Maximum, 60-min Mean Wind Speed	45.4 mph at 131 ft AGL – 3/21/1997 9:00 a.m.		
Estimated Wind Power Class ^c	Class 4 (490 W/m ² at 131 ft AGL)		

^a Spring is defined as the months of March, April, and May. Spring 1995 begins with March 1995. Data recovery rates at 33, 82, and 131 feet were 68%, 52%, and 70%, respectively.

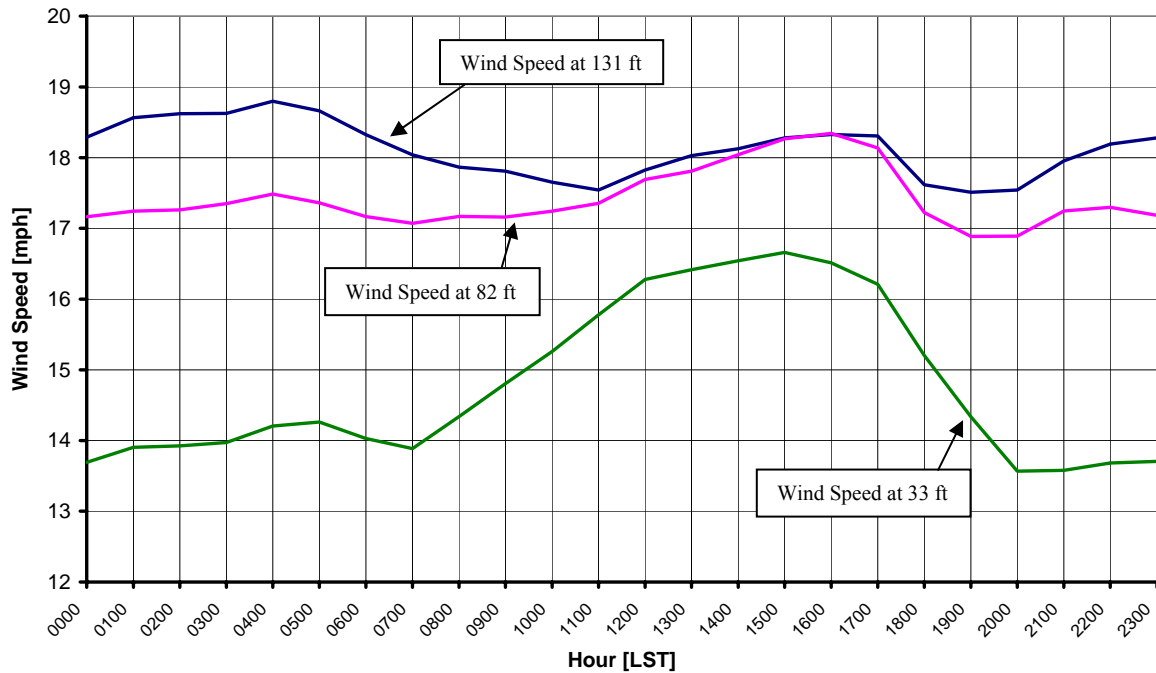
^b Above ground level.

^c Air temperature was not factored into calculations.

Average Hourly Wind Speeds

LST ^d	131 ft AGL		82 ft AGL		33 ft AGL	
	mph	m/s	mph	m/s	mph	m/s
0000	18.3	8.18	17.2	7.67	13.7	6.12
0100	18.6	8.30	17.2	7.71	13.9	6.22
0200	18.6	8.32	17.3	7.72	13.9	6.23
0300	18.6	8.33	17.3	7.76	14.0	6.25
0400	18.8	8.40	17.5	7.82	14.2	6.35
0500	18.7	8.34	17.4	7.76	14.3	6.38
0600	18.3	8.19	17.2	7.67	14.0	6.27
0700	18.0	8.06	17.1	7.63	13.9	6.21
0800	17.9	7.99	17.2	7.68	14.3	6.41
0900	17.8	7.96	17.2	7.67	14.8	6.62
1000	17.7	7.89	17.2	7.71	15.3	6.82
1100	17.5	7.84	17.4	7.76	15.8	7.05
1200	17.8	7.97	17.7	7.91	16.3	7.28
1300	18.0	8.06	17.8	7.96	16.4	7.34
1400	18.1	8.10	18.0	8.07	16.5	7.39
1500	18.3	8.17	18.3	8.17	16.7	7.45
1600	18.3	8.19	18.3	8.20	16.5	7.38
1700	18.3	8.18	18.1	8.11	16.2	7.25
1800	17.6	7.87	17.2	7.70	15.2	6.80
1900	17.5	7.83	16.9	7.55	14.3	6.41
2000	17.5	7.84	16.9	7.55	13.6	6.06
2100	18.0	8.03	17.2	7.71	13.6	6.07
2200	18.2	8.13	17.3	7.73	13.7	6.12
2300	18.3	8.17	17.2	7.68	13.7	6.13

**North Dakota Utility Study – Alfred Site
Springs 1995, 1996 & 1997**



^d Local standard time.



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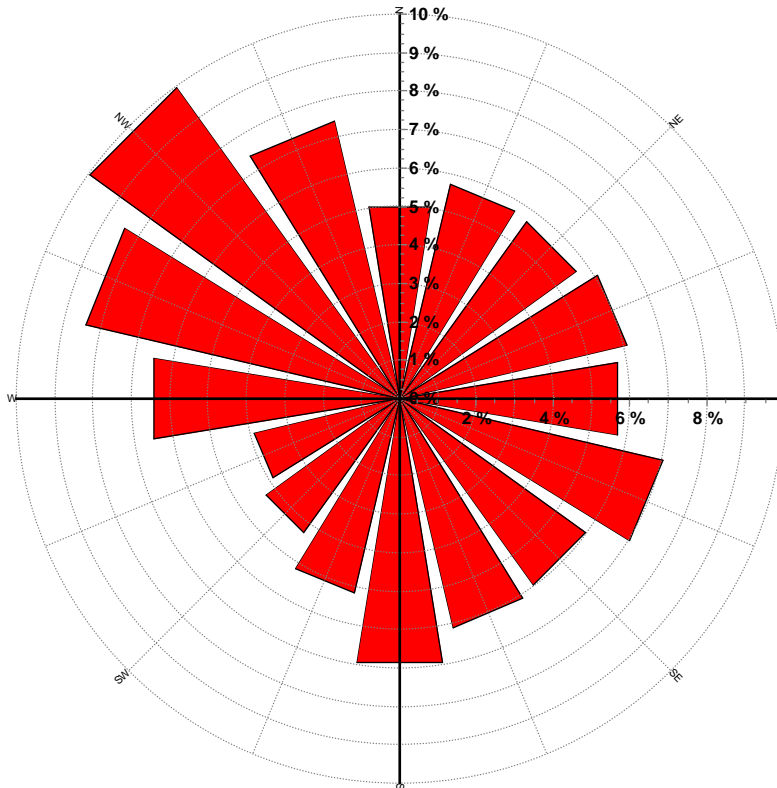
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Wind Directional Frequency

Winds from the... Frequency (%)

NNW	7.4
NW	9.9
WNW	8.4
W	6.5
WSW	3.9
SW	4.3
SSW	5.2
S	7.0
SSE	6.1
SE	6.0
ESE	7.0
E	5.7
ENE	6.1
NE	5.7
NNE	5.7
N	5.0

North Dakota Utility Study – Alfred Site
Wind Rose for 131 ft AGL
Springs 1995, 1996 & 1997



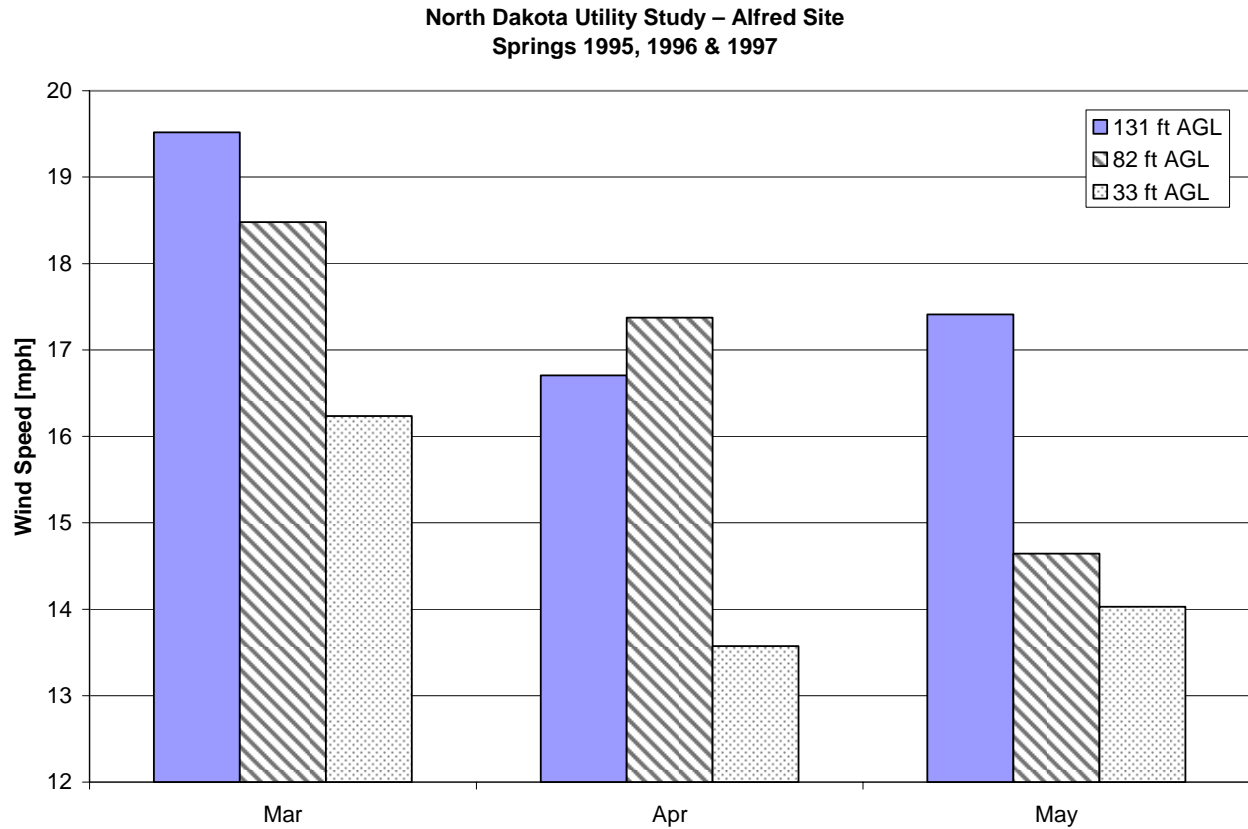
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Monthly Wind Speed Averages

Month	131 ft AGL		82 ft AGL		33 ft AGL	
	mph	m/s	mph	m/s	mph	m/s
Mar	19.5	8.73	18.5	8.26	16.2	7.26
Apr*	16.7	7.47	17.4	7.77	13.6	6.07
May	17.4	7.78	14.6	6.55	14.0	6.27

* A decrease in average wind speed with height is due to differences in data recovery.



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