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WIND MONITORING PROGRAMS IN MONTANA

Most wind monitoring in Montana has been conducted by the following agencies:

- National Weather Service (NWS);
- Federal Aviation Administration (FAA);
- U.S. Air Force (USAF);
- Air Quality Bureau, Montana Department of Health and Environmental Sciences (AQB);
- U.S. Environmental Protection Agency (EPA);
- Bureau of Reclamation, U.S. Department of the Interior (BOR);
- Montana Department of Natural Resources and Conservation (DNRC);
- U.S. Department of Energy (DOE);
- Bonneville Power Administration (BPA)
- Western Area Power Administration (WAPA)
- Private companies.

These monitoring programs were established for various reasons: to provide wind information for aviation, agriculture, and general public use (NWS, USAF, FAA); to study the dispersion of air pollutants (AQB, EPA, private companies); and to investigate potential wind power applications (DNRC, Bureau of Reclamation, DOE, BPA, WAPA, private companies).

Because of the different objectives of these monitoring efforts, the data have been collected by different means and organized into different formats (see Appendix A for a discussion of wind measurement in general). The periods of monitoring, averaging times, and representativeness of the data vary among the different monitoring programs. Information on various Montana wind monitoring site locations, monitoring agencies, and monitoring duration are presented on Map II-1 and Tables II-1 and II-2. The site numbers on the map are referenced in the tables. The 1987 additions may be found at the end of the tables.

Other groups, such as the U.S. Forest Service, also have conducted some monitoring in Montana. Some of these programs are discussed in Appendix C.

NWS/FAA/USAF

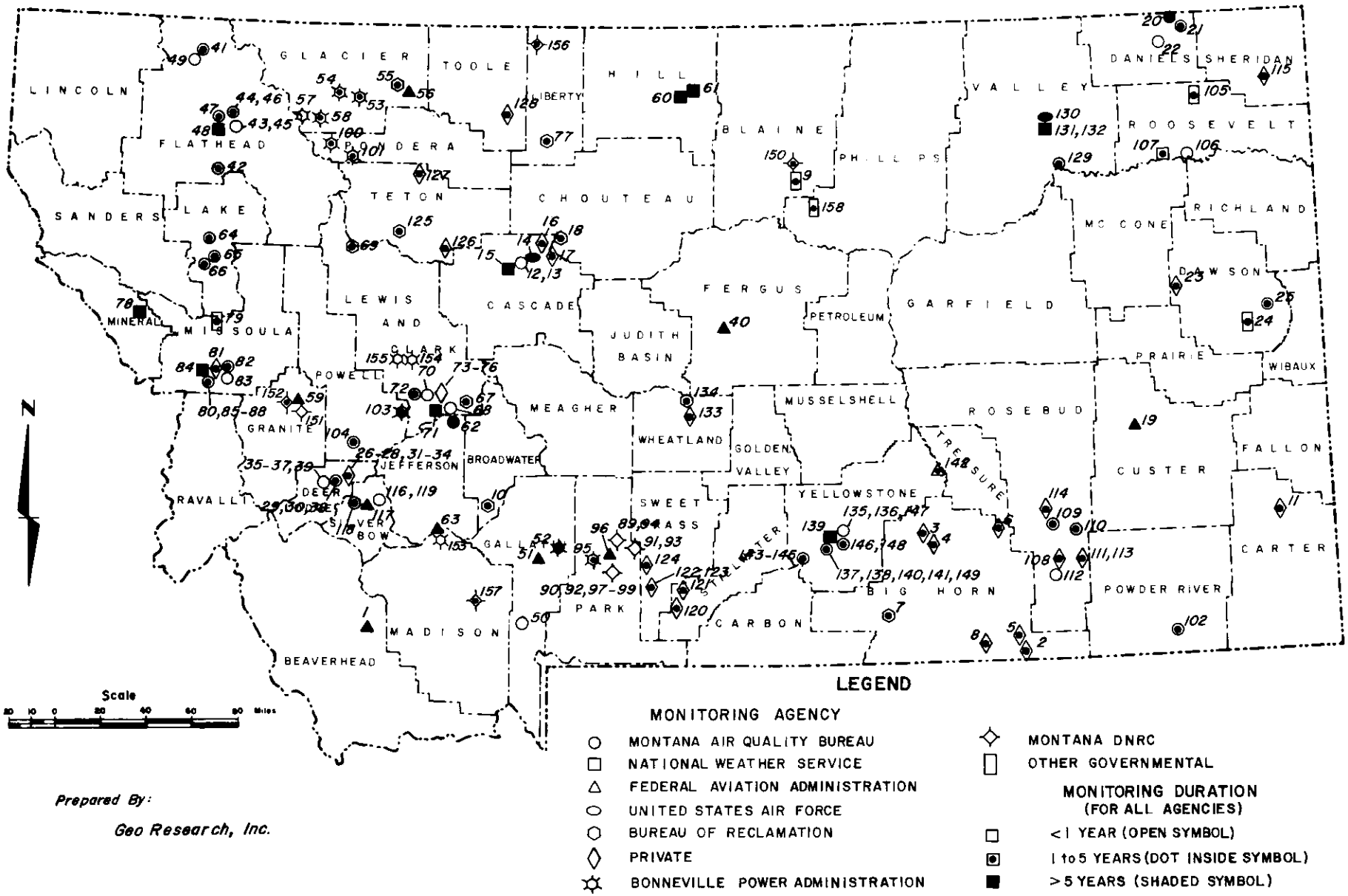
The National Weather Service is charged with providing weather-related services to aviation, agriculture, and the general public. To accomplish these tasks, the NWS, among other things, gathers meteorological data at several airports in Montana. The Federal Aviation Administration, to meet its responsibility to aviation, also collects meteorological data at many airports around the state. The United States Air Force has gathered similar data at Malmstrom Air Force Base and Glasgow Air Force Base. Over time, these agencies have assembled a large meteorological data base.

Data are taken hourly at NWS, FAA, and USAF airport stations. The meteorological parameters recorded include sky condition, visibility, barometric pressure, temperature, dewpoint, wind direction, wind speed, peak wind gust, and other significant data. The data are recorded approximately 10 minutes before each hour and are intended to represent a one-minute averaging period. Wind direction is read to the nearest 10 degrees, and wind speed is read to the nearest whole knot.

The advantages of the NWS, FAA, and USAF data are:

- They are available from a number of stations;
- The stations are distributed over a large geographic area;
- The data records typically are of many years' duration;
- The quality assurance program followed by the NWS, FAA, and USAF is good, so data accuracy is high;
- The data are readily available, both in hard copy and in machine-readable form.

Map II-1. Wind Monitoring Site Locations, Showing Monitoring Agencies and Durations



Prepared By:

Geo Research, Inc.

LEGEND

MONITORING AGENCY

- ○ MONTANA AIR QUALITY BUREAU
- □ NATIONAL WEATHER SERVICE
- △ FEDERAL AVIATION ADMINISTRATION
- ⬭ UNITED STATES AIR FORCE
- ⬡ BUREAU OF RECLAMATION
- ◇ PRIVATE
- ☼ BONNEVILLE POWER ADMINISTRATION
- ✧ MONTANA DNRC
- ▯ OTHER GOVERNMENTAL

MONITORING DURATION (FOR ALL AGENCIES)

- □ < 1 YEAR (OPEN SYMBOL)
- ◉ 1 to 5 YEARS (DOT INSIDE SYMBOL)
- ■ > 5 YEARS (SHADED SYMBOL)

Table II-1. Wind Monitoring Site Locations

Site No.	Site Name	County	Location
1	Dillon FAA Airport	Beaverhead	45 15 00N 112 33 00W
	Dillon FAA Airport	Beaverhead	45 15 00N 112 33 00W
2	Decker Coal #8	Big Horn	45 03 19N 106 48 17W
3	Hardin	Big Horn	45 46 00N 107 49 00W
4	Hardin MDN	Big Horn	45 30 00N 107 30 00W
5	Spring Creek #1	Big Horn	45 07 02N 106 52 32W
6	Westmoreland Absaloka #2	Big Horn	45 46 27N 107 04 57W
7	Yellowtail Dam	Big Horn	45 19 06N 107 57 45W
8	Youngs Creek	Big Horn	45 02 00N 107 01 00W
9	Hays Forestry Shop	Blaine	45 55 44N 108 41 42W
10	Three Forks	Broadwater	45 59 20N 111 35 32W
11	Ekalaka	Carter	45 57 37N 104 25 18W
12	Great Falls City Sewage Pump	Cascade	47 30 00N 111 15 00W
13	Great Falls Kiwanis Park	Cascade	47 30 35N 111 16 32W
14	Great Falls Malmstrom Air Force Base	Cascade	47 31 12N 111 10 12W
	Great Falls Malmstrom Air Force Base	Cascade	47 31 12N 111 10 12W
	Great Falls Malmstrom Air Force Base	Cascade	47 31 12N 111 10 12W
15	Great Falls NWS Airport	Cascade	47 28 48N 111 22 12W
	Great Falls NWS Airport	Cascade	47 28 48N 111 22 12W
	Great Falls NWS Airport	Cascade	47 28 48N 111 22 12W
16	Portage	Cascade	47 35 00N 111 05 00W
17	Salem	Cascade	47 34 22N 111 02 34W
18	Highwood Bench	Chouteau	47 41 01N 110 54 02W
19	Miles City FAA Airport	Custer	46 25 48N 105 52 12W
	Miles City FAA Airport	Custer	46 25 48N 105 52 12W
20	Scobey Border	Daniels	49 00 00N 105 24 00W
21	Scobey Hanrahan	Daniels	48 53 47N 105 17 05W
22	Scobey Richardson	Daniels	48 48 35N 105 25 13W
23	Circle	Dawson	47 15 42N 105 16 05W
24	Glendive	Dawson	47 05 39N 104 43 01W
25	Glendive Microwave	Dawson	47 08 14N 104 32 45W
26	Anaconda #2 Pond Discharge	Deer Lodge	46 09 42N 112 46 57W
27	Anaconda C-Hill	Deer Lodge	46 06 03N 112 56 56W
28	Anaconda County Airport	Deer Lodge	46 08 45N 112 51 13W
29	Anaconda Highway Junction	Deer Lodge	46 08 09N 112 53 17W
30	Anaconda Lincoln School	Deer Lodge	46 07 31N 112 56 34W
31	Anaconda Mill Creek	Deer Lodge	46 06 19N 112 52 45W

Table II-1. Wind Monitoring Site Locations (cont'd.)

Site No.	Site Name	County	Location
32	Anaconda Water Office	Deer Lodge	46 08 51N 112 56 51W
33	Anaconda Weather Hill	Deer Lodge	46 05 51N 112 54 51W
34	Anaconda West Gate	Deer Lodge	46 06 03N 112 54 41W
35	Antelope	Deer Lodge	46 00 00N 113 00 00W
36	Kucera	Deer Lodge	46 00 00N 113 00 00W
37	Opportunity Main Street	Deer Lodge	46 08 45N 112 49 37W
38	Poor Farm	Deer Lodge	46 10 47N 112 52 46W
39	Tailings Pond	Deer Lodge	46 00 00N 113 00 00W
40	Lewistown FAA Airport	Fergus	47 03 00N 109 27 00W
	Lewistown FAA Airport	Fergus	47 03 00N 109 27 00W
41	Big Prairie	Flathead	48 48 29N 114 18 41W
42	Bigfork Ranger Station	Flathead	48 04 00N 114 05 57W
43	Columbia Falls Brandt	Flathead	48 18 22N 114 15 00W
44	Columbia Falls Delbon	Flathead	48 24 01N 114 08 21W
45	Columbia Falls Geis	Flathead	48 20 00N 114 08 30W
46	Columbia Falls Water Supply (Trailer)	Flathead	48 24 05N 114 08 32W
	Columbia Falls Water Supply	Flathead	48 24 05N 114 08 32W
47	Kalispell Airport	Flathead	48 18 38N 114 16 00W
48	Kalispell NWS Airport	Flathead	48 18 40N 114 16 00W
	Kalispell NWS Airport	Flathead	48 18 40N 114 16 00W
	Kalispell NWS Airport	Flathead	48 18 40N 114 16 00W
	Kalispell NWS Airport	Flathead	48 18 40N 114 16 00W
49	Polebridge	Flathead	48 45 53N 114 17 01W
50	Big Sky Golf Course	Gallatin	45 16 04N 111 17 23W
51	Bozeman FAA Airport	Gallatin	45 46 48N 111 09 00W
	Bozeman FAA Airport	Gallatin	45 46 48N 111 09 00W
52	Bridger Bowl	Gallatin	45 48 00N 111 05 30W
53	Blackfoot	Glacier	48 35 20N 112 52 35W
54	Browning RR Depot	Glacier	48 32 15N 113 01 00W
55	Cut Bank	Glacier	48 47 54N 112 19 37W
56	Cut Bank FAA Airport	Glacier	48 36 00N 112 22 12W
	Cut Bank FAA Airport	Glacier	48 36 00N 112 22 12W
57	Duck Lake	Glacier	48 50 20N 113 20 05W
58	Rainbow Field	Glacier	48 21 21N 113 08 10W
59	Drummond FAA Airport	Granite	46 37 10N 113 11 50W
	Drummond FAA Airport	Granite	46 37 10N 113 11 50W
60	Havre NWS Airport	Hill	48 33 00N 109 46 30W
	Havre NWS Airport	Hill	48 33 00N 109 46 30W
61	Havre NWS City Office	Hill	48 34 00N 109 40 00W

Table II-1. Wind Monitoring Site Locations (cont'd.)

Site No.	Site Name	County	Location
62	Microwave Tower	Jefferson	46 33 27N 111 55 01W
63	Whitehall FAA Airport	Jefferson	45 49 12N 112 12 00W
64	Polson	Lake	47 41 20N 114 07 27W
65	Ronan	Lake	47 30 54N 114 05 46W
66	Ronan Ninepipes	Lake	47 27 35N 114 07 59W
67	Canyon Ferry Dam	Lewis and Clark	46 43 54N 111 43 28W
68	East Helena A & W	Lewis and Clark	46 35 23N 111 54 25W
69	Gibson Dam	Lewis and Clark	47 37 47N 112 48 00W
70	Hadfield West Main	Lewis and Clark	46 35 18N 111 55 52W
71	Helena NWS Airport Helena NWS Airport	Lewis and Clark Lewis and Clark	46 36 21N 112 00 00W 46 36 21N 112 00 00W
72	Kleffner Residence	Lewis and Clark	46 00 00N 112 30 00W
73	Kleffner Road	Lewis and Clark	46 00 00N 112 30 00W
74	Sinter Plant	Lewis and Clark	46 34 39N 111 55 21W
75	Water Tower	Lewis and Clark	46 34 39N 111 55 21W
76	Zinc Plant	Lewis and Clark	46 34 39N 111 55 21W
77	Tiber Dam	Liberty	48 19 33N 111 04 47W
78	Superior NWS Airport	Mineral	47 10 48N 114 52 12W
79	Evaro	Missoula	47 02 00N 114 04 42W
80	Missoula Fire Lab	Missoula	46 33 00N 114 03 00W
81	Missoula Hoerner-Waldorf #1	Missoula	46 57 03N 114 10 35W
82	Missoula Lions Park	Missoula	46 51 05N 114 00 25W
83	Missoula Malfunction Junction	Missoula	46 51 07N 114 00 53W
84	Missoula NWS Airport Missoula NWS Airport Missoula NWS Airport	Missoula Missoula Missoula	46 55 40N 114 05 50W 46 55 40N 114 05 50W 46 55 40N 114 05 50W
85	Missoula Olofson	Missoula	46 49 49N 114 04 24W
86	Missoula Rose Park	Missoula	46 51 26N 114 00 14W
87	Missoula Stiegler	Missoula	46 54 15N 114 08 14W
88	Missoula University of Montana	Missoula	46 51 50N 113 58 40W
89	Charles Hillman Ranch	Park	45 43 24N 110 28 24W
90	George Meyers Ranch	Park	45 40 03N 110 32 10W
91	Gordon Brittan Ranch	Park	45 42 16N 110 23 37W
92	Harvatts Flat	Park	45 38 55N 110 32 35W
93	Hunters Hot Springs	Park	45 45 16N 110 15 38W
94	Koffee Kup Ranch	Park	45 46 38N 110 30 54W

Table II-1. Wind Monitoring Site Locations (cont'd.)

Site No.	Site Name	County	Location
95	Livingston Candidate Wind Turbine Site	Park	45 40 27N 110 30 01W
96	Livingston FAA Airport Livingston FAA Airport	Park Park	45 40 12N 110 31 48W 45 40 12N 110 31 48W
97	Livingston West	Park	45 39 23N 110 34 37W
98	McGuire Hill	Park	45 40 23N 110 33 53W
99	Park County Landfill	Park	45 40 07N 110 31 12W
100	Heart Butte	Pondera	48 17 42N 112 53 03W
101	Swift Dam	Pondera	48 13 15N 112 47 00W
102	Broadus Randall Ranch	Powder River	45 24 27N 105 27 50W
103	McDonald Pass	Powell	46 35 42N 112 17 05W
104	Powell County Courthouse	Powell	46 23 49N 112 43 39W
105	Give Out Morgan	Roosevelt	48 28 24N 105 07 54N
106	Poplar	Roosevelt	48 06 10N 105 11 55W
107	Wolf Point	Roosevelt	48 05 00N 105 32 00W
108	Badger Peak	Rosebud	45 38 58N 106 33 23W
109	Colstrip BN	Rosebud	45 51 30N 106 34 43W
110	Colstrip McRae	Rosebud	45 45 47N 106 23 09W
111	Garfield Peak	Rosebud	45 40 08N 106 27 54W
112	Lame Deer-Fisher Butte	Rosebud	45 37 34N 106 39 14W
113	Morningstar Lookout	Rosebud	45 40 06N 106 31 04W
114	Western Energy #12	Rosebud	45 52 06N 106 38 27W
115	Reserve	Sheridan	48 30 58N 104 18 23W
116	Butte Alpine West	Silver Bow	46 00 45N 112 30 32W
117	Butte FAA Airport	Silver Bow	45 57 00N 112 30 00W
118	Butte Hebgen Park	Silver Bow	46 00 13N 112 31 29W
119	Harrison Fire Station	Silver Bow	46 00 00N 112 30 00W
120	Anaconda Stillwater Mine Site	Stillwater	45 25 30N 109 53 11W
121	Hertzler Ranch	Stillwater	45 32 26N 109 47 10W
122	Long Mountain	Sweetgrass	45 32 20N 110 05 01W
123	Main Station	Sweetgrass	45 30 37N 110 06 07W
124	Woolsey Ranch	Sweetgrass	45 35 05N 110 06 37W
125	Choteau	Teton	47 44 36N 112 26 05W
126	Fairfield	Teton	47 36 31N 112 02 43W
127	Pendroy	Teton	48 07 45N 112 26 20W
128	Devon	Toole	48 26 00N 111 27 00W

Table II-1. Wind Monitoring Site Locations (cont'd.)

Site No.	Site Name	County	Location
129	Fort Peck	Valley	47 59 48N 106 29 59W
130	Glasgow Air Force Base	Valley	48 24 00N 106 31 20W
	Glasgow Air Force Base	Valley	48 24 00N 106 31 20W
	Glasgow Air Force Base	Valley	48 24 00N 106 31 20W
131	Glasgow NWS Airport	Valley	48 13 12N 106 37 12W
	Glasgow NWS Airport	Valley	48 13 12N 106 37 12W
	Glasgow NWS Airport	Valley	48 13 12N 106 37 12W
132	Glasgow NWS City Office	Valley	48 11 00N 106 38 00W
133	Harlowton	Wheatland	46 28 00N 109 52 00W
134	Judith Gap	Wheatland	46 36 57N 109 46 11W
135	Billings AQB Office	Yellowstone	45 46 57N 108 31 56W
136	Billings 11th & 27th	Yellowstone	45 46 18N 108 29 57W
137	Billings Central Park	Yellowstone	45 46 51N 108 32 19W
138	Billings Metra	Yellowstone	45 47 55N 108 28 45W
139	Billings NWS Airport	Yellowstone	45 48 00N 108 31 48W
	Billings NWS Airport	Yellowstone	45 48 00N 108 31 48W
	Billings NWS Airport	Yellowstone	45 48 00N 108 31 48W
140	Billings Taft School	Yellowstone	45 46 36N 108 29 40W
141	Coburn Road	Yellowstone	45 47 00N 108 28 00W
142	Custer FAA Airport	Yellowstone	46 09 00N 107 31 00W
	Custer FAA Airport	Yellowstone	46 09 00N 107 31 00W
143	Laurel BN	Yellowstone	45 41 00N 108 42 00W
144	Laurel Farm	Yellowstone	45 39 39N 108 46 12W
145	Laurel New Farm	Yellowstone	45 40 07N 108 44 25W
146	Lockwood Park	Yellowstone	45 48 00N 108 27 00W
147	Lockwood School	Yellowstone	45 47 57N 108 26 30W
148	North Johnson Lane	Yellowstone	45 49 00N 108 26 00W
149	Shawnee Park	Yellowstone	45 49 28N 108 23 56W
1987 Additions			
150	Hays	Blaine	48 06 17N 108 42 43W
151	Drummond—1	Granite	46 37 00N 113 11 00W
152	Drummond—2	Granite	46 39 52N 113 15 06W
153	Whitehall	Jefferson	45 55 57N 112 04 30W
154	Sieben 1	Lewis and Clark	46 55 00N 112 13 00W
155	Sieben 2	Lewis and Clark	46 50 30N 112 15 30W
156	Whitlash	Liberty	48 51 36N 111 14 46W
157	Norris Hill	Madison	45 29 42N 111 41 57W
158	Mt. Antione	Phillips	47 57 20N 108 33 02W

Table II-2. Monitoring Agency and Duration

Site No.	Site Name	Monitoring Agency	Duration of Monitoring
1	Dillon FAA Airport	Federal Aviation Administration	1951 JUN 19 - 1963 OCT 29
	Dillon FAA Airport	Federal Aviation Administration	1963 OCT 30 - 1973 JUN 18
2	Decker Coal #8	Decker Coal Company	1980 DEC 01 - 1982 MAY 31
3	Hardin	Montana Power Company	1980 MAY - 1981 APR
4	Hardin MDN	Air Quality Bureau	1972 APR - 1973 JUL
5	Spring Creek #1	Spring Creek Coal Company	1981 JAN 01 - 1981 DEC 31
6	Westmoreland Absaloka #2	Westmoreland Resources, Inc.	1980 AUG 01 - 1982 MAR 29
7	Yellowtail Dam	Bureau of Reclamation	1980 JAN 21 - 1981 JAN 31
8	Youngs Creek	Shell Oil Company	1975 OCT - 1979 DEC
9	Hays Forestry Shop	Fort Belknap Reservation	1980 AUG - ?
10	Three Forks	Bureau of Reclamation	1981 JUN 27 - 1982 SEP 15
11	Ekalaka	Southeast Electric Co-op	1982 MAR 11 - 1986 MAY 18
12	Great Falls City Sewage Pump	Air Quality Bureau	1972 JUN - 1972 AUG
13	Great Falls Kiwanis Park	Air Quality Bureau	1980 JAN 01 - 1980 FEB 16
14	Great Falls Malmstrom Air Force Base	United States Air Force	1949 JAN 01 - 1953 MAY 31
	Great Falls Malmstrom Air Force Base	United States Air Force	1954 MAR 01 - 1958 FEB 28
	Great Falls Malmstrom Air Force Base	United States Air Force	1958 APR 01 - 1968 NOV 30
15	Great Falls NWS Airport	National Weather Service	1948 JAN 01 - 1959 FEB 02
	Great Falls NWS Airport	National Weather Service	1959 FEB 03 - 1964 DEC 31
	Great Falls NWS Airport	National Weather Service	1965 JAN 01 - 1978 DEC 31
16	Portage	Montana Power Company	1980 APR - ?
17	Salem	Montana Power Company	1980 MAY 01 - 1984 MAR
18	Highwood Bench	Bureau of Reclamation	1981 JUN 05 - 1983 JUN 17
19	Miles City FAA Airport	Federal Aviation Administration	1948 JAN 01 - 1964 DEC 31
	Miles City FAA Airport	Federal Aviation Administration	1965 JAN 01 - 1978 DEC 31
20	Scobey Border	Air Quality Bureau	1977 MAR 02 - 1982 APR 26
21	Scobey Hanrahan	Air Quality Bureau	1981 APR 01 - 1982 MAR 31
22	Scobey Richardson	Air Quality Bureau	1979 JAN 16 - 1979 MAY 31
23	Circle	McCone Electric Co-op	1982 MAR 11 - 1985 OCT 30
24	Glendive	Environmental Protection Agency	1974 DEC 26 - 1976 FEB 29
25	Glendive Microwave	Air Quality Bureau	1975 JUL 26 - 1977 SEP 14
26	Anaconda #2 Pond Discharge	Anaconda Copper Company	1976 DEC 04 - 1979 MAY 31
27	Anaconda C-Hill	Anaconda Copper Company	1976 JAN 01 - 1979 MAY 31
28	Anaconda County Airport	Anaconda Copper Company	1976 DEC 04 - 1979 MAY 31
29	Anaconda Highway Junction	Air Quality Bureau	1975 JUN 11 - 1979 DEC 28
30	Anaconda Lincoln School	Air Quality Bureau	1978 JUL 03 - 1981 MAY 19
31	Anaconda Mill Creek	Anaconda Copper Company	1976 DEC 04 - 1979 MAY 31
32	Anaconda Water Office	Anaconda Copper Company	1976 DEC 04 - 1979 MAY 31
33	Anaconda Weather Hill	Anaconda Copper Company	1976 DEC 04 - 1979 MAY 31

Table II-2. Monitoring Agency and Duration (cont'd.)

Site No.	Site Name	Monitoring Agency	Duration of Monitoring
34	Anaconda West Gate	Anaconda Copper Company	1976 JAN 01 - 1979 MAY 31
35	Antelope	Air Quality Bureau	1973 FEB - 1973 AUG
36	Kucera	Air Quality Bureau	1972 DEC - 1973 MAY
37	Opportunity Main Street	Air Quality Bureau	1972 JUN - 1972 NOV
38	Poor Farm	Air Quality Bureau	1971 DEC - 1973 JAN
39	Tailings Pond	Air Quality Bureau	1974 JUL - 1974 OCT
40	Lewistown FAA Airport	Federal Aviation Administration	1949 DEC 21 - 1962 AUG 15
	Lewistown FAA Airport	Federal Aviation Adminsitration	1964 OCT 13 - 1978 DEC 31
41	Big Prairie	Air Quality Bureau	1978 NOV 07 - 1982 JAN 04
42	Bigfork Ranger Station	Air Quality Bureau	1979 NOV 16 - 1980 JUN 10
	Bigfork Ranger Station	Air Quality Bureau	1981 JUL 15 - 1981 AUG 30
43	Columbia Falls Brandt	Air Quality Bureau	1977 MAR 02 - 1977 JUN 06
	Columbia Falls Brandt	Air Quality Bureau	1978 MAR 17 - 1978 MAY 29
44	Columbia Falls Delbon	Air Quality Bureau	1977 MAR 14 - 1978 MAY 31
45	Columbia Falls Geis	Air Quality Bureau	1978 JAN - 1978 MAY
46	Columbia Falls Water Supply (Trailer)	Air Quality Bureau	1972 FEB - 1974 JUN
	Columbia Falls Water Supply	Air Quality Bureau	1977 FEB 16 - 1979 OCT 22
47	Kalispell Airport	Air Quality Bureau	1976 DEC 21 - 1977 OCT 20
	Kalispell Airport	Air Quality Bureau	1978 JUN 23 - 1982 FEB 15
48	Kalispell NWS Airport	National Weather Service	1949 MAY 01 - 1953 JUN 30
	Kalispell NWS Airport	National Weather Service	1953 JUL 01 - 1959 JUN 30
	Kalispell NWS Airport	National Weather Service	1959 JUL 01 - 1964 JUN 30
	Kalispell NWS Airport	National Weather Service	1964 JUL 01 - 1978 DEC 31
49	Polebridge	Air Quality Bureau	1978 SEP 14 - 1978 NOV 07
50	Big Sky Golf Course	Air Quality Bureau	1981 JUL 03 - 1982 MAY 15
51	Bozeman FAA Airport	Federal Aviation Administration	1948 JAN 01 - 1951 APR 27
	Bozeman FAA Airport	Federal Aviation Administration	1951 APR 28 - 1954 DEC 31
52	Bridger Bowl	U.S. Forest Service	1968 - 1983 APR
53	Blackfoot	Bonneville Power Administration	1981 SEP - 1984 JUL
	Blackfoot	Bonneville Power Administration	1984 JUL 30 - 1985 OCT 29
54	Browning RR Depot	Burlington Northern	1981 APR - 1983 APR
55	Cut Bank	Bureau of Reclamation	1981 JUN 03 - 1983 AUG 3
56	Cut Bank FAA Airport	Federal Aviation Administration	1949 NOV 22 - 1959 OCT 03
	Cut Bank FAA Airport	Federal Aviation Administration	1959 OCT 04 - 1978 DEC 31
57	Duck Lake	Bonneville Power Administration	1982 NOV - 1984 APR
58	Rainbow Field	Bonneville Power Administration	1981 SEP - 1982 NOV
59	Drummond FAA Airport	Federal Aviation Administration	1948 JAN 01 - 1950 OCT 15
	Drummond FAA Airport	Federal Aviation Administration	1950 OCT 16 - 1954 DEC 31
60	Havre NWS Airport	National Weather Service	1961 FEB 01 - 1964 DEC 31
	Havre NWS Airport	National Weather Service	1967 JAN 01 - 1978 DEC 31
61	Havre NWS City Office	National Weather Service	1950 MAY 01 - 1956 OCT 31
62	Microwave Tower	Air Quality Bureau	1975 JAN 16 - 1981 DEC 31
63	Whitehall FAA Airport	Federal Aviation Administration	1948 JAN 01 - 1954 DEC 31

Table II-2. Monitoring Agency and Duration (cont'd.)

Site No.	Site Name	Monitoring Agency	Duration of Monitoring
64	Polson	Air Quality Bureau	1978 OCT 19 - 1980 SEP 17
	Polson	Air Quality Bureau	1981 MAR 01 - 1981 DEC 05
65	Ronan	Air Quality Bureau	1979 JAN 03 - 1980 JUN 15
66	Ronan Ninepipes	Air Quality Bureau	1980 DEC 11 - 1982 FEB 26
67	Canyon Ferry Dam	Bureau of Reclamation	1980 JAN 31 - 1981 JAN 31
68	East Helena A & W	Air Quality Bureau	1980 FEB 01 - 1980 JUN 30
69	Gibson Dam	Bureau of Reclamation	1980 JAN 15 - 1981 JAN 31
70	Hadfield West Main	Air Quality Bureau	1981 OCT 01 - 1981 DEC 31
71	Helena NWS Airport	National Weather Service	1948 JAN 01 - 1961 SEP 19
	Helena NWS Airport	National Weather Service	1961 SEP 20 - 1978 DEC 31
72	Kleffner Residence	Air Quality Bureau	1968 JUL - 1971 SEP
73	Kleffner Road	ASARCO	1981 OCT 01 - 1981 DEC 31
74	Sinter Plant	ASARCO	1981 OCT 01 - 1981 DEC 31
75	Water Tower	ASARCO	1981 OCT 01 - 1981 DEC 31
76	Zinc Plant	ASARCO	1981 OCT 01 - 1981 DEC 31
77	Tiber Dam	Bureau of Reclamation	1980 JAN 16 - 1981 JAN 31
78	Superior NWS Airport	National Weather Service	1948 JAN 01 - 1953 NOV 30
79	Evaro	Flathead Reservation	1980 OCT - ?
80	Missoula Fire Lab	Air Quality Bureau	1977 DEC 01 - 1980 APR 30
81	Missoula Hoerner-Waldorf #1	Hoerner-Waldorf	1977 JUL 01 - 1982 MAR 31
82	Missoula Lions Park	Air Quality Bureau	1977 DEC 02 - 1980 JUL 27
83	Missoula Malfunction Junction	Air Quality Bureau	1980 APR 03 - 1980 MAY 26
84	Missoula NWS Airport	National Weather Service	1948 JAN 01 - 1958 APR 03
	Missoula NWS Airport	National Weather Service	1958 APR 04 - 1964 DEC 31
	Missoula NWS Airport	National Weather Service	1965 JAN 01 - 1978 DEC 31
85	Missoula Olofson	Air Quality Bureau	1978 JUL 15 - 1980 MAR 17
86	Missoula Rose Park	Air Quality Bureau	1980 NOV 14 - 1982 APR 26
87	Missoula Stiegler	Air Quality Bureau	1978 MAY 01 - 1980 MAR 17
88	Missoula University of Montana	Air Quality Bureau	1978 MAY 01 - 1980 MAR 17
89	Charles Hillman Ranch	Montana DNRC	1979 MAR - 1979 APR
90	George Meyers Ranch	Montana DNRC	1979 MAR - 1979 APR
91	Gordon Brittan Ranch	Montana DNRC	1979 MAY - 1979 JUL
92	Harvatts Flat	Montana DNRC	1978 DEC - 1979 FEB
93	Hunters Hot Springs	Montana DNRC	1978 DEC - 1979 FEB
94	Koffee Kup Ranch	Montana DNRC	1978 DEC - 1979 FEB
95	Livingston Candidate Wind Turbine Site	Bonneville Power Administration	1980 SEP 01 - 1982 JUN 30
96	Livingston FAA Airport	Federal Aviation Administration	1948 JAN 01 - 1953 JUL 04
	Livingston FAA Airport	Federal Aviation Administration	1953 JUL 05 - 1954 DEC 31

Table II-2. Monitoring Agency and Duration (cont'd.)

Site No.	Site Name	Monitoring Agency	Duration of Monitoring
97	Livingston West	Montana DNRC	1979 MAY - 1979 JUL
98	McGuire Hill	Montana DNRC	1979 MAY - 1979 JUL
99	Park County Landfill	Montana DNRC	1979 MAR - 1979 APR
100	Heart Butte Heart Butte	Bonneville Power Administration Bonneville Power Administration	1981 SEP - 1982 OCT 1982 NOV 13 - 1984 MAY 29
101	Swift Dam	Bonneville Power Administration	1981 SEP - 1984 JUN
102	Broadus Randall Ranch	Air Quality Bureau	1976 MAR 06 - 1978 AUG 27
103	McDonald Pass	Bonneville Power Administration	1981 OCT - 1982 DEC
104	Powell County Courthouse	Air Quality Bureau	1971 APR - 1972 MAY
105	Give Out Morgan	Fort Peck Reservation	1980 AUG - ?
106	Poplar	Air Quality Bureau	1976 MAY 18 - 1976 SEP 30
107	Wolf Point	National Weather Service	1958 JAN - 1962 DEC
108	Badger Peak	GeoResearch, Inc. (MPC/NCT)	1981 APR 01 - Present
109	Colstrip BN	Air Quality Bureau	1975 JAN 01 - 1979 AUG 22
110	Colstrip McRae	Air Quality Bureau	1975 JAN 01 - 1976 AUG 04
111	Garfield Peak	GeoResearch, Inc. (MPC/NCT)	1981 APR 01 - Present
112	Lame Deer-Fisher Butte	Air Quality Bureau	1976 MAY 16 - 1976 OCT 26
113	Morningstar Lookout	GeoResearch, Inc. (MPC/NCT)	1981 APR 01 - Present
114	Western Energy #12	Western Energy Company	1981 JAN 01 - 1982 MAR 31
115	Reserve	Sheridan Electric Co-op	1982 JAN 29 - 1985 JUN 30
116	Butte Alpine West	Air Quality Bureau	1977 AUG 01 - 1978 JUN 15
117	Butte FAA Airport	Federal Aviation Administration	1948 JAN 01 - 1960 DEC 31
118	Butte Hebgen Park	Air Quality Bureau	1978 JUN 15 - 1980 DEC 10
119	Harrison Fire Station	Air Quality Bureau	1972 JAN - 1972 MAR
120	Anaconda Stillwater Mine Site	Anaconda Minerals Company	1980 AUG - 1981 JUL
121	Hertzler Ranch	Anaconda Minerals Company	1980 AUG - 1981 JUL
122	Long Mountain	PGM Resources	1981 OCT - 1982 SEP
123	Main Station	PGM Resources	1981 OCT - 1982 SEP
124	Woolsey Ranch	PGM Resources	1981 OCT - 1982 SEP
125	Choteau	Bureau of Reclamation	1981 JUN 04 - 1983 AUG 16
126	Fairfield	Sun River Electric Co-op	1981 DEC 30 - 1985 JAN 3
127	Pendroy	Sun River Electric Co-op	1982 MAR 17 - 1984 DEC 19
128	Devon	Montana Power Company	1980 APR - 1981 APR
129	Fort Peck	Air Quality Bureau	1977 MAY 07 - 1979 JUL 19
130	Glasgow Air Force Base Glasgow Air Force Base Glasgow Air Force Base	United States Air Force United States Air Force Old West Regional Commission	1958 OCT 01 - 1961 JUN 07 1961 JUN 08 - 1968 JUN 30 1977 OCT 25 - 1978 AUG 31

Table II-2. Monitoring Agency and Duration (cont'd.)

Site No.	Site Name	Monitoring Agency	Duration of Monitoring
131	Glasgow NWS Airport	National Weather Service	1955 OCT 01 - 1962 AUG 05
	Glasgow NWS Airport	National Weather Service	1962 AUG 06 - 1968 MAY 31
	Glasgow NWS Airport	National Weather Service	1968 JUN 01 - 1978 DEC 31
132	Glasgow NWS City Office	National Weather Service	1948 JAN 01 - 1955 OCT 31
133	Harlowton	Electric Power Research Institute	1981 JUN - 1982 OCT
134	Judith Gap	Bureau of Reclamation	1981 AUG 01 - 1985 JUL 31
135	Billings AQB Office	Air Quality Bureau	1970 JUN - 1971 APR
136	Billings 11th & 27th	Air Quality Bureau	1975 SEP 21 - 1976 APR 30
137	Billings Central Park	Air Quality Bureau	1978 AUG 10 - 1980 MAY 08
138	Billings Metra	Air Quality Bureau	1980 SEP 13 - 1982 MAY 03
139	Billings NWS Airport	National Weather Service	1948 JAN 01 - 1958 JUN 25
	Billings NWS Airport	National Weather Service	1958 JUN 26 - 1964 DEC 31
	Billings NWS Airport	National Weather Service	1965 JAN 01 - 1978 DEC 31
140	Billings Taft School	Air Quality Bureau	1980 AUG 07 - 1982 MAY 17
141	Coburn Road	Air Quality Bureau	1981 SEP - 1982 SEP
142	Custer FAA Airport	Federal Aviation Administration	1948 JAN 01 - 1949 MAY 31
	Custer FAA Airport	Federal Aviation Administration	1949 JUN 01 - 1950 MAY 30
143	Laurel BN	Air Quality Bureau	1981 SEP - 1982 SEP
144	Laurel Farm	Air Quality Bureau	1976 MAY 01 - 1980 JUL 15
145	Laurel New Farm	Air Quality Bureau	1980 NOV 13 - 1982 MAY 17
146	Lockwood Park	Air Quality Bureau	1981 SEP - 1982 SEP
147	Lockwood School	Air Quality Bureau	1979 AUG 02 - 1980 JUN 11
148	North Johnson Lane	Air Quality Bureau	1981 SEP - 1982 SEP
149	Shawnee Park	Air Quality Bureau	1981 JAN 22 - 1982 APR 30
1987 Additions			
150	Hays	Montana DNRC	1984 JAN 1 - 1985 JUL 15
151	Drummond—1	Montana DNRC	1982 DEC 17 - 1983 JUL 26
152	Drummond—2	Montana DNRC	1983 DEC 2 - 1985 MAY 29
153	Whitehall	Bonneville Power Administration	1983 SEP - 1984 JUL
154	Sieben 1	Bonneville Power Administration	1984 FEB 18 - 1984 JUL 28
155	Sieben 2	Bonneville Power Administration	1983 OCT - 1984 JUL
156	Whitlash	Montana DNRC	1983 NOV 18 - 1985 JUL 24
157	Norris Hill	Montana DNRC	1984 JAN 10 - 1986 MAR 31
158	Mt. Antione	WAPA	1984 FEB 8 - 1985 AUG 5

NOTE: The monitoring duration represents the full or known period of monitoring at a given site, or the period for which data were available to DNRC. Sites at which monitoring is continuing, but data were not available, are marked "present"; sites for which the status is unknown are marked "?".

The disadvantages of these data are:

- The values of wind speed and direction are approximately 1-minute averages, so users must be cautious when comparing them to other data sets;
- Anemometer heights are not standardized in most cases;
- Particularly in earlier years, the anemometers were located on rooftops; such an exposure creates the possibility that the wind speed values recorded were too high, due to acceleration of air over the buildings;
- The stations are located at airports and/or urban areas, which typically are areas where high winds occur less frequently.

In spite of these deficiencies, the NWS, FAA, and USAF data are a valuable resource for evaluating potential wind power.

Data from these sources are gathered and stored by the National Climatic Center (NCC) in Asheville, North Carolina. This data set has been analyzed by Battelle Pacific Northwest Laboratories, and a Wind Energy Data Base has been assembled. The data base consists of several data files:

- Station Description — physical characteristics of the station;
- Means and Frequency Distribution — mean wind speed and wind energy flux, as well as wind speed frequency distributions;
- Intra-/Inter-Annual — monthly and annual means and standard deviations of wind speed, wind energy flux, and other parameters;
- Climatic Means and Weather Events — monthly means of air density, temperature and pressure, and occurrences of significant weather events;
- Persistence of Speed and Direction — number of episodes of given duration when the wind speed exceeded a threshold or the wind direction remained constant;
- Wind Data Grid — wind energy flux, land surface form, resource certainty rating, and resource areal distribution by grid cell.

These files were obtained from Battelle, and portions of the data files were incorporated into the *Montana Wind Energy Atlas.*

The data that Battelle obtained from NCC consisted of either summarized, digitized, or unsummarized data from NWS, FAA, and USAF airport stations. The NWS and FAA data obtained by Battelle were collected from 1948 through 1978, except for those sites where monitoring was discontinued at an earlier date. The USAF data obtained by Battelle were collected from 1948 through 1968, when the USAF stopped coding their meteorological data for the NCC. All NCC data originally are in unsummarized formats consisting of the original station weather records. The data for some stations have been analyzed by NCC and condensed into wind summaries. Data from some airport stations have been digitized by NCC and made available in machine-readable form.

When Battelle conducted its analyses, it used summarized or digitized data whenever possible. If both summarized and digitized data were available, the digitized data were used to prepare a more extensive characterization of the wind resource. Unsummarized data were used only when no summarized or digitized data were available.

For stations with digitized data, Battelle calculated the average wind power density from:

$$\overline{P} = \frac{1}{2n} \sum_{i=1}^{n} \rho_i V_i^3$$

where:

- n = the number of observations in the averaging period;
- ρ_i = the density (in kg/m^3) computed from the station pressure and temperature;
- V_i = the wind speed (in m/s) at the i th observation time.

For stations with wind summaries, $\overline{P}$ was calculated from:

$$\overline{P} = \frac{1}{2} \overline{\rho} \sum_{j=1}^{c} f_j V_j^3$$

where:

- $\overline{\rho}$ = the mean air density;
- c = the number of wind speed classes;
- f_j = frequency of occurrence of winds in the j th class;
- V_j = the median wind speed of the j th class.

In those cases for which unsummarized wind data were assessed, the seasonal and annual average speeds, $\overline{V}$, were estimated from a visual examination of one year's original weather records. The wind power density, $\overline{P}$, then was estimated by assuming the speed frequency distribution followed a Rayleigh distribution. (A Rayleigh distribution is a mathematical approximation of actual wind speed distributions; see Appendix B.) The wind power density was calculated as follows:

$$\overline{P} = 0.955 \, \overline{\rho} \, \overline{V}^3$$

Battelle also adjusted the long-term mean wind speed and wind power density to a reference level of 10 meters by means of the one-seventh power law. In the data tables presented in this *Atlas,* the mean wind speeds and wind power densities presented are for the anemometer height, and have not been adjusted to a reference height.

Montana Air Quality Bureau

The Montana Air Quality Bureau (AQB) is responsible for monitoring air quality in the state and for safeguarding the public health. To accomplish these goals, the AQB operates a number of air monitoring stations around the state. In addition, the AQB has conducted special studies, such as the Montana Air Pollution Study and the Flathead River Basin Environmental Impact Study, to evaluate meteorological conditions and air quality in specific areas.

The AQB also requires operators of certain facilities, such as power plants and smelters, to conduct monitoring programs around their projects. The data thus collected are submitted to the AQB and become part of AQB's data file.

During the past 10 years, the AQB has accumulated a large amount of meteorological data. The advantages of these data are:

- The data were collected from a large number of sites;
- The sites are distributed over a large geographic area;
- The data represent a one-hour averaging time;
- The data are readily available, in SAROAD format, in hard copy or in machine-readable form (SAROAD is the Environmental Protection Agency's standard format for coding aerometric data).

The disadvantages of these data are:

- In most cases, the monitoring period was short (less than three years);
- Anemometer heights were not standardized until recently;
- The data set, especially for earlier years, contains a significant number of errors;
- In many cases, the data are not very complete;
- The quality assurance program for meteorological data was inadequate until recently; in particular, alignment of wind direction sensors sometimes was inaccurate;
- Many of the stations were located in urban areas.

U.S. Environmental Protection Agency

The U.S. Environmental Protection Agency (EPA) has, from time to time, conducted wind monitoring studies in Montana. These studies generally were conducted as a part of studies of dispersion around sources of pollution. One such study, which was designed to study sulfur dioxide concentrations in the air near East Helena, was conducted in 1969 and 1970. Another study was conducted near Glendive in 1975 and 1976. The EPA also is a major source of funds for other agencies, such as the AQB, which conduct studies of their own. For example, two major monitoring studies conducted by the AQB, the Flathead River Basin Environmental Impact Study and the Poplar River Study, were funded largely by EPA.

Bureau of Reclamation, U.S. Department of Interior

The Bureau of Reclamation (BOR), in recent years, has initiated studies to identify areas of high potential for wind energy generation. The Northern Great Plains Wind Energy Study is one such monitoring effort. Wind monitoring sites were established at 15 sites in Montana, North Dakota, South Dakota, and Wyoming. The BOR provided the Montana data for inclusion in the *Montana Wind Energy Atlas.*

The data set contains the following information:

- Average hourly wind speed;
- Maximum wind speed during the hour;
- Minimum wind speed during the hour;
- Average cube of the hourly wind speed;
- Standard deviation of the hourly speed;
- Wind direction.

The data were recorded on cassette tape by a computerized data acquisition system. The tapes were further processed by computer to yield the completed data set.

The advantages of these data are:

- The sites were located in areas of high wind potential;
- Parameters of interest to wind developers were monitored;
- Anemometer heights were standardized;
- The data are readily available, either in hard copy or machine-readable form.

Monitoring continued at these sites for at least two years.

Montana Department of Natural Resources and Conservation

The Montana Department of Natural Resources and Conservation (DNRC) assumed responsibility for operating the BOR wind monitoring sites in Montana in 1982. The monitoring equipment later was moved to other sites. Since 1982, DNRC has completed monitioring the wind at four sites and plans to continue monitoring at four other sites (Augusta, Norris Hill, Ringling, and Whitehall) at least through June 1987. BOR has provided data reduction services and issued quarterly reports for these sites.

DNRC, through its Renewable Energy Program, has funded other wind monitoring efforts around the state. Among these studies are the Wind Energy Survey (Livingston to Springdale) and the Montana Wind Energy Research and Development Program.

The advantages of these data are:

- The sites have been located in areas of high wind potential;
- The studies were specifically designed to provide data for wind energy applications;
- Anemometer heights were standardized.

The only disadvantage of these data is that the monitoring periods were short, generally a few months to a year.

In 1985, DNRC funded wind monitoring outside of Anaconda and across the Livingston bench, as well as a wind shear study in Livingston at the old Candidate Wind Turbine Site.

U.S. Department of Energy

The Department of Energy (DOE), as part of various federal energy programs, conducted research activities to provide information on wind characteristics throughout the United States. These efforts included:

- Wind Energy Resource Assessment;
- Siting Methodologies;
- Meteorological Characteristics for Design and Performance Evaluation;
- Meteorological Characteristics for Wind Energy Conversion System Operations;
- Site Selection Support;
- Site Meteorological Measurements;
- Large Machine Site Evaluation.

As part of this program, DOE collected wind data at the Livingston Candidate Wind Turbine site since September 1980. This monitoring effort was taken over by the Bonneville Power Administration in October 1982 through June 1983.

The data collected at Livingston consist of hourly averages of wind speed and wind direction at three different anemometer heights (10, 30, and 45.7 meters above ground level). The data were recorded digitally at the site on a data cassette recording system. An instantaneous sample of data was recorded every two minutes. These data are summarized in the *Montana Wind Energy Atlas.*

The advantages of these data are:

- The site is located in an area of high wind energy potential;
- Data were collected at three different anemometer heights;
- The data set is nearly complete;
- The system was designed specifically to provide data for wind energy applications;
- The data are readily available, either in hard copy or in machine-readable form.

Bonneville Power Administration

The Bonneville Power Administration (BPA) in 1980 initiated the Wind Regional Energy Assessment Program (Wind REAP). This five-year program was designed to assess the wind resource potential throughout the Pacific Northwest. The actual research was carried out by Oregon State University. The program consisted of fly-overs of areas to identify high potential sites and later location of wind monitoring devices at some of those sites. Nine sites were instrumented in Montana.

The advantages of these data are:

- The sites were located in areas of high wind potential;
- Most of the anemometers were set at a standard height of 30 feet;
- The data are readily available in hard copy and data for three sites are available in machine-readable form;
- Information on the suitability of the sites for wind farm development was collected.

The disadvantages of the data are:

- Only wind-run data were collected at six of the sites, and at two of the other three, only wind-run data were collected for most of the time they were in operation;
- Each of the wind-run data sets had more than twenty percent missing data;
- Four of the sites had less than one year's data.

The data and reports are available at the Wind Resources Assessment Laboratory, Oregon State University.

Western Area Power Administration

The Western Area Power Administration initiated a Wind Prospecting Program in 1981. Six sites in the program were located in Montana, mostly in the eastern part of the state. Because the data were only available in hard copy, the sites were included in Appendix C and not in the main text of the *Atlas*. Four of the sites appeared to have substantial wind resources.

Private Companies

Many private companies have conducted their own wind monitoring programs in Montana. Most of these programs have been initiated to comply with air quality permit requirements. The scope of these efforts ranges from one year of monitoring at a single anemometer height to several years of monitoring at different anemometer heights. An example of the latter program is Montana Power Company's Salem site, where wind monitoring at three levels on a 100-meter tower ran from May 1980 to March 1984.

The advantages of the data gathered by these various private companies are:

- The anemometer heights are usually standardized;
- The data sets generally are complete and accurate;
- The data generally are available to the public in standard formats if submitted to fulfill permit requirements.

The disadvantages of these data are:

- Monitoring, in most cases, has taken place for only one year;
- The data may be confidential.

Other privately funded monitoring studies included the multi-site Northern Cheyenne Tribe-Montana Power Company monitoring system near Lame Deer, operated by GeoResearch, Inc., and the visibility monitoring site near Harlowton, operated for the Electric Power Research Institute (EPRI).

Conclusions

A large amount of wind data has been gathered in Montana over the last 30 years. The wind monitoring sites, however, generally have been concentrated in urban and other areas of low wind potential. In some areas of high wind potential, particularly along the eastern slopes of the Rockies, monitoring has been light. Winds in certain other promising areas, such as the upper Musselshell valley above Harlowton and the eastern slopes of the Little Belt Mountains from Utica to Geyser, also have not been adequately investigated. Considerable wind data, nonetheless, are available for areas of potential interest to wind developers.

When comparing wind data from sites where monitoring has been conducted, caution must be exercised. The monitoring objectives of the various programs have differed from agency to agency and often from project to project. As a result, other aspects of the monitoring programs also have differed.

Collection methods and averaging times have varied and anemometer heights have not been standardized, even within studies. The most serious problem with comparability of the data, in fact, is the difference in anemometer heights. Ten meters has now become the standard exposure height for most purposes, but some agencies, particularly the NWS and FAA, are still using an anemometer height of approximately 6 meters. A discussion of collection methods and averaging times is given in the site analysis for each station included in the *Atlas*, and the anemometer height is listed in the site's wind speed frequency table.

Quality assurance activities also have been inadequate in some cases, particularly for wind direction monitoring, occasionally leading to serious questions concerning the data. Wind direction data, however, are not as critical to wind energy analyses as wind speed data, which by and large appear to be valid or within a range of reasonable values.

The period of record, the number of observations, and the percentage of data recovery also have varied. Most monitoring efforts have been short term, lasting for three years or less. Many of these projects, moreover, were not conducted during the same years. The number of observations and data completeness also are a concern with some of the data sets, particularly where missing observations or data are not distributed uniformly among the months. Sites where monitoring took place for less than one year's duration, or with long periods or large amounts of missing data, generally have not been included in the *Atlas*.

Therefore, although caution must be exercised in comparing the wind data gathered at the various stations around Montana, the data presented and analyzed in this *Atlas* have been screened to form a basis for site evaluations and comparisons that will be within acceptable and reasonable statistical limits (see Appendix B).