CAFO Monitoring in 2003

The first permanent stations to monitor hydrogen sulfide (H_2S) near animal feeding operations were begun in the spring of 2002 near the towns of Williams and Clarion. Four new sites (near Atlantic, Malcom, Sioux Center, and Woodbine) were added in 2003, and monitoring for ammonia (NH_3) was added. The monitoring stations were sited near some the largest confined animal feeding operations in the state. Details regarding the general location of these monitors, and the name of the closest animal feeding operation, are presented in the table on the following page. Raw data used to create this document was downloaded from the AIRS database on 1/23/04, and includes all data for calendar year 2003. Sites established in the fall of 2003 are not included.

Viking Lake State Park is a background ammonia monitoring site with no nearby animal feeding operations. Data from this site has been included in this report for comparison purposes. Summary charts of daily and hourly data completeness and measured pollutant concentration statistics and several types of graphs have been plotted for each site.

- The concentration of each pollutant (in parts per billion by volume) is plotted against time. Data that failed quality assurance checks, along with instrument malfunctions, has been omitted.

- Pollutant concentration plotted against wind direction. The direction the wind is coming from is specified using an angle between 0 and 359 degrees. 0 represents a wind from due north, 90 from due east, etc.

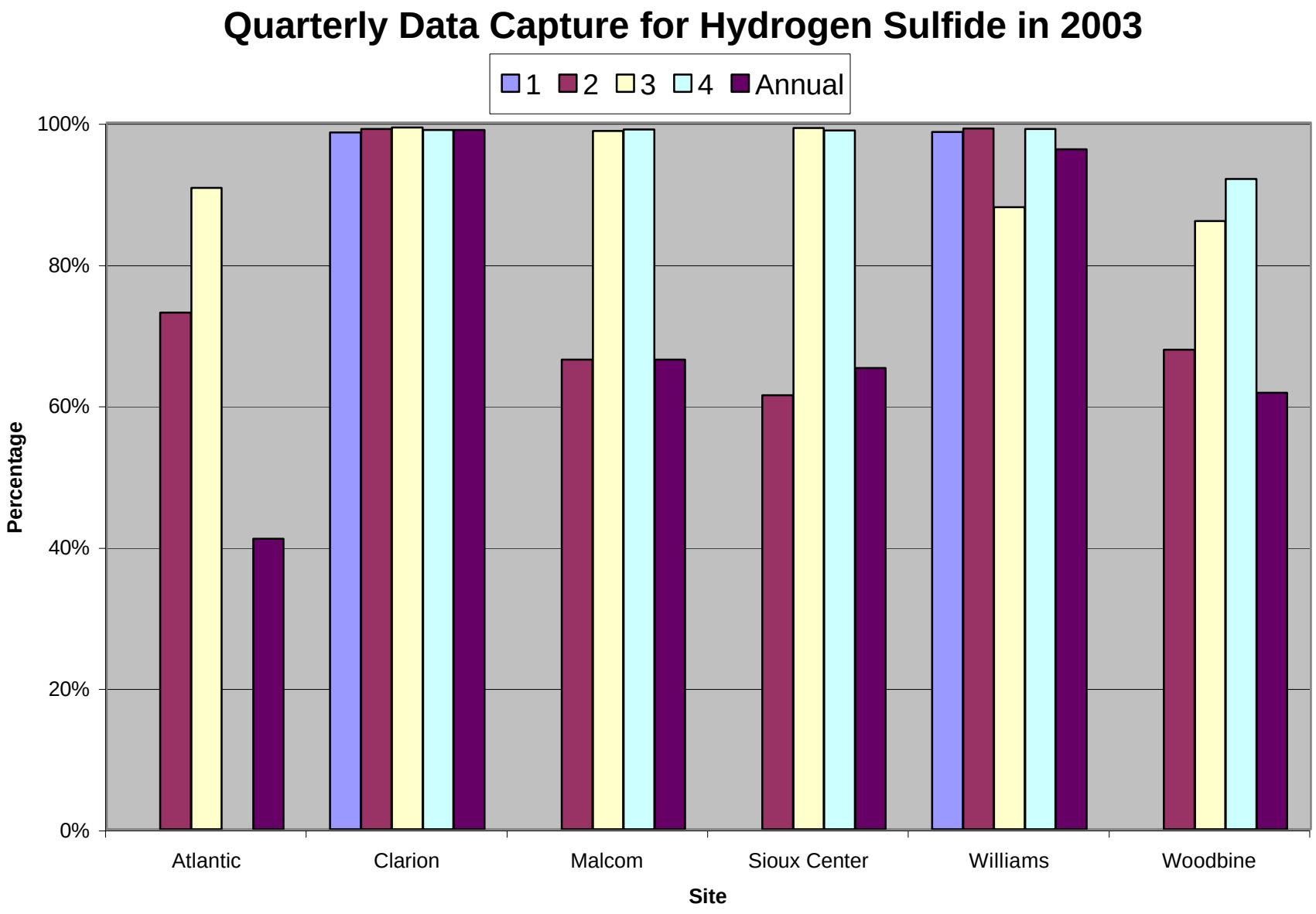
- The third type of graph shows the relationship between pollutant concentration and wind speed. This type of graph can be useful along with locational data for analysis of the pollutant dilution and possible effects of other sources.

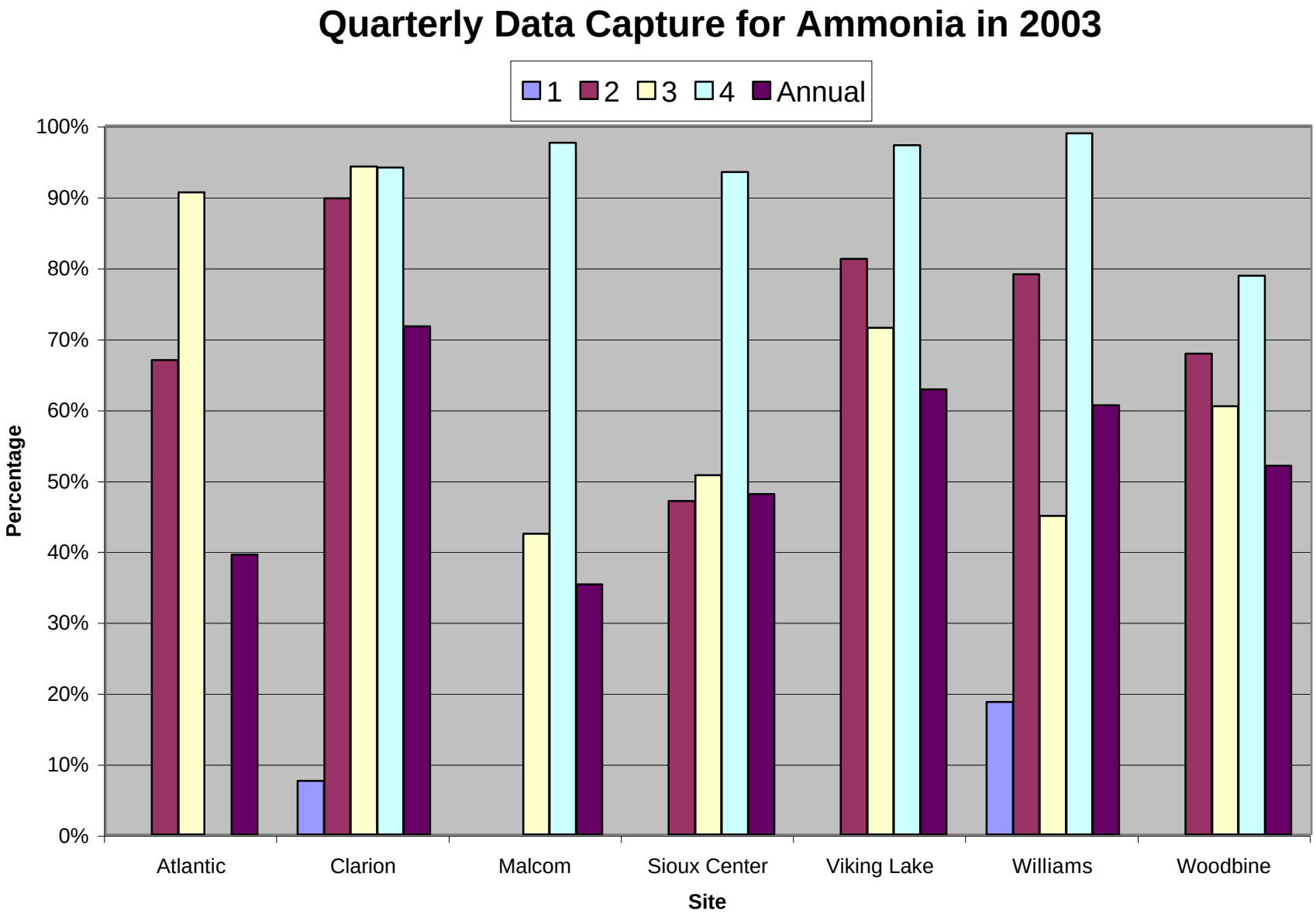
- Graphs have also been included to show if there is any relationship between the measured concnetrations of hydrogen sulfide and ammonia where appropriate.

CAFO Sites Operating in 2003

NearbyTown	County	Animal Type at Closest Operation	Name of Closest Operation	Site Type	Permitted Weight in lbs.	Monitoring Begin Date	Site Closed
Atlantic	Cass	Dairy Cattle	Milk Unlimited	2	4,320,000	4/24/03	9/23/03
Clarion	Wright	Swine	DeCoster #15 Sow Site	2	1,827,265	4/1/02	
Malcom	Powesheik	Poultry	Fremont Farms	2	12,150,000	5/1/03	
Sioux Center	Sioux	Beef	Sioux CO-OP	1	10,000,000	5/5/03	
Williams	Hamilton	Swine	DeCoster #7 Finishing	3	2,100,000	5/1/02	
Woodbine	Harrison	Swine	Geiman Finishing	1	3,000,000	4/29/03	

Site Type	Desription
1	In ambient air, on property associated with a residence, close to an animal feeding operation
2	In ambient air, on property associated with a residence, close to house
3	In ambient air, not on property associated with a residence


Quarterly Data Capture for Hydrogen Sulfide in 2003
1
2
3
4
Annual
100%
80%
60%
40%
20%
0%
Percentage
Atlantic
Clarion
Malcom
Sioux Center
Williams
Woodbine
Site


Quarterly Data Capture for Ammonia in 2003
1
2
3
4
Annual
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Percentage
Atlantic
Clarion
Malcom
Sioux Center
Viking Lake
Williams
Woodbine
Site

Hydrogen Sulfide

2003 Daily Summary Statistics

Statistic/Site Name	Atlantic	Clarion	Malcom	Sioux Center	Viking Lake	Williams	Woodbine
Minimum (ppb)	0	0	0	0	n/a	0	0
Average (ppb)	8	2	0	44	n/a	3	5
Maximum (ppb)	102	20	4	330	n/a	30	37
Count	150	363	245	240	n/a	354	213
Capture Percentage	41%	99%	67%	66%	n/a	97%	58%

Percentile/Site Name	Atlantic	Clarion	Malcom	Sioux Center	Viking Lake	Williams	Woodbine
100%	102	20	4	330	n/a	30	37
99%	76	11	2	269	n/a	20	31
98%	65	9	1	240	n/a	15	24
97%	53	7	1	199	n/a	11	22
96%	46	6	1	195	n/a	11	22
95%	43	5	1	187	n/a	10	17
94%	39	5	1	157	n/a	9	16
93%	33	5	1	149	n/a	8	15
92%	27	4	1	143	n/a	7	14
91%	25	4	1	135	n/a	7	14
90%	22	4	1	116	n/a	6	13

Maximum Value/Site Name	Atlantic	Clarion	Malcom	Sioux Center	Viking Lake	Williams	Woodbine
1	102	20	4	330	n/a	30	37
2	81	12	2	296	n/a	29	34
3	70	12	2	278	n/a	27	31
4	65	12	2	255	n/a	23	28
5	58	11	2	249	n/a	17	24
6	47	11	1	238	n/a	16	23
7	46	10	1	200	n/a	15	22
8	44	10	1	199	n/a	15	22
9	41	8	1	197	n/a	14	22
10	38	8	1	195	n/a	13	22

Hydrogen Sulfide

2003 Hourly Summary Statistics

Statistic/Site Name	Atlantic	Clarion	Malcom	Sioux Center	Viking Lake	Williams	Woodbine
Minimum (ppb)	0	0	0	0	-	0	0
Average (ppb)	1	0	0	9	-	1	1
Maximum (ppb)	102	20	4	330	-	30	37
Count	3601	8670	5821	5716	-	8429	5413
Capture Percentage	41%	99%	66%	65%	-	96%	62%

Percentile/Site Name	Atlantic	Clarion	Malcom	Sioux Center	Viking Lake	Williams	Woodbine
100%	102	20	4	330	-	30	37
99%	18	4	1	137	-	6	12
98%	10	3	1	96	-	4	9
97%	7	2	1	76	-	3	8
96%	5	2	1	62	-	3	7
95%	4	2	0	52	-	3	6
94%	3	1	0	42	-	2	5
93%	2	1	0	36	-	2	4
92%	2	1	0	32	-	2	4
91%	2	1	0	27	-	2	3
90%	1	1	0	24	-	2	3

Maximum Value/Site Name	Atlantic	Clarion	Malcom	Sioux Center	Viking Lake	Williams	Woodbine
1	102	20	4	330	-	30	37
2	81	19	2	296	-	29	34
3	71	17	2	278	-	27	31
4	70	15	2	255	-	23	28
5	65	12	2	249	-	18	28
6	58	12	1	238	-	17	27
7	47	12	1	227	-	16	24
8	46	11	1	200	-	16	24
9	46	11	1	199	-	15	23
10	44	11	1	197	-	15	22

Ammonia

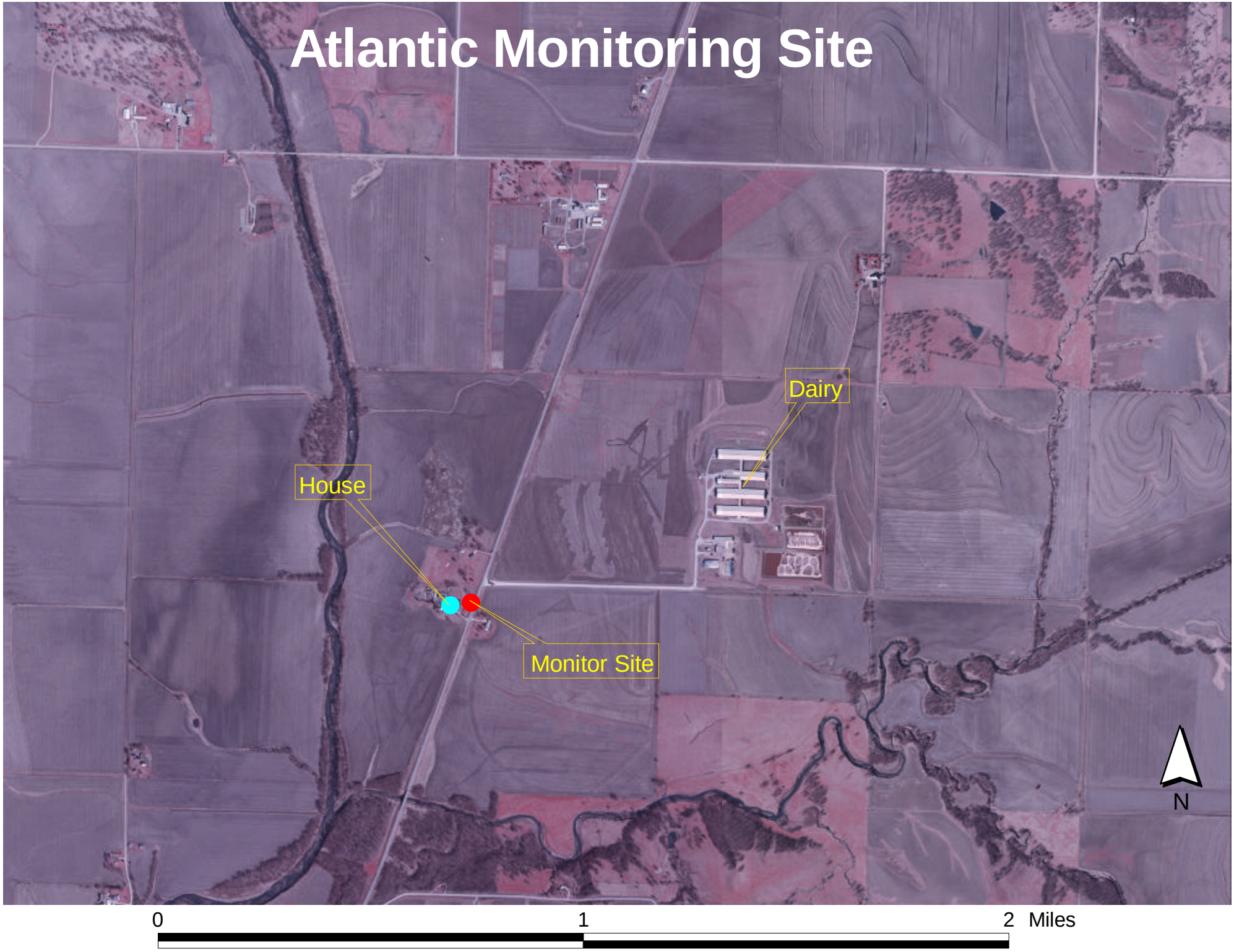
2003 Hourly Summary Statistics

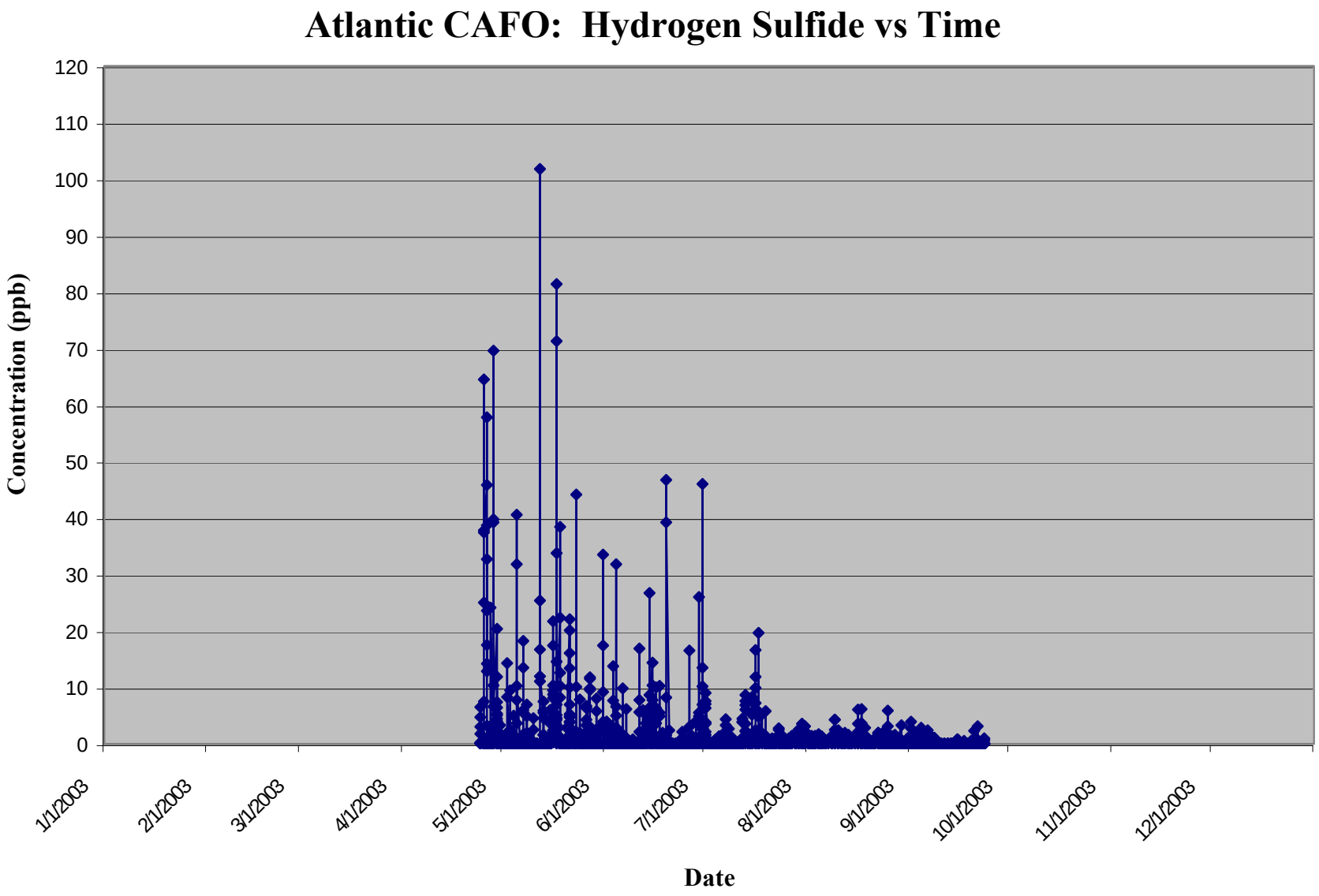
Statistic/Site Name	Atlantic	Clarion	Malcom	Sioux Center	Viking Lake	Williams	Woodbine
Minimum (ppb)	0	0	0	0	0	0	0
Average (ppb)	67	30	23	23	3	27	63
Maximum (ppb)	651	1182	399	358	143	1104	697
Count	3460	6280	3091	4208	5496	5303	4555
Capture Percentage	39%	72%	35%	48%	63%	61%	52%

Percentile/Site Name	Atlantic	Clarion	Malcom	Sioux Center	Viking Lake	Williams	Woodbine
100%	651	1182	399	358	143	1104	697
99%	242	288	106	186	20	272	265
98%	205	219	80	138	15	174	220
97%	191	162	68	118	13	141	199
96%	178	133	62	101	12	117	184
95%	168	114	58	83	11	98	172
94%	159	102	55	74	10	87	165
93%	152	91	52	67	9	80	158
92%	147	81	50	60	9	71	151
91%	143	74	48	56	8	63	147
90%	137	67	46	52	8	58	142

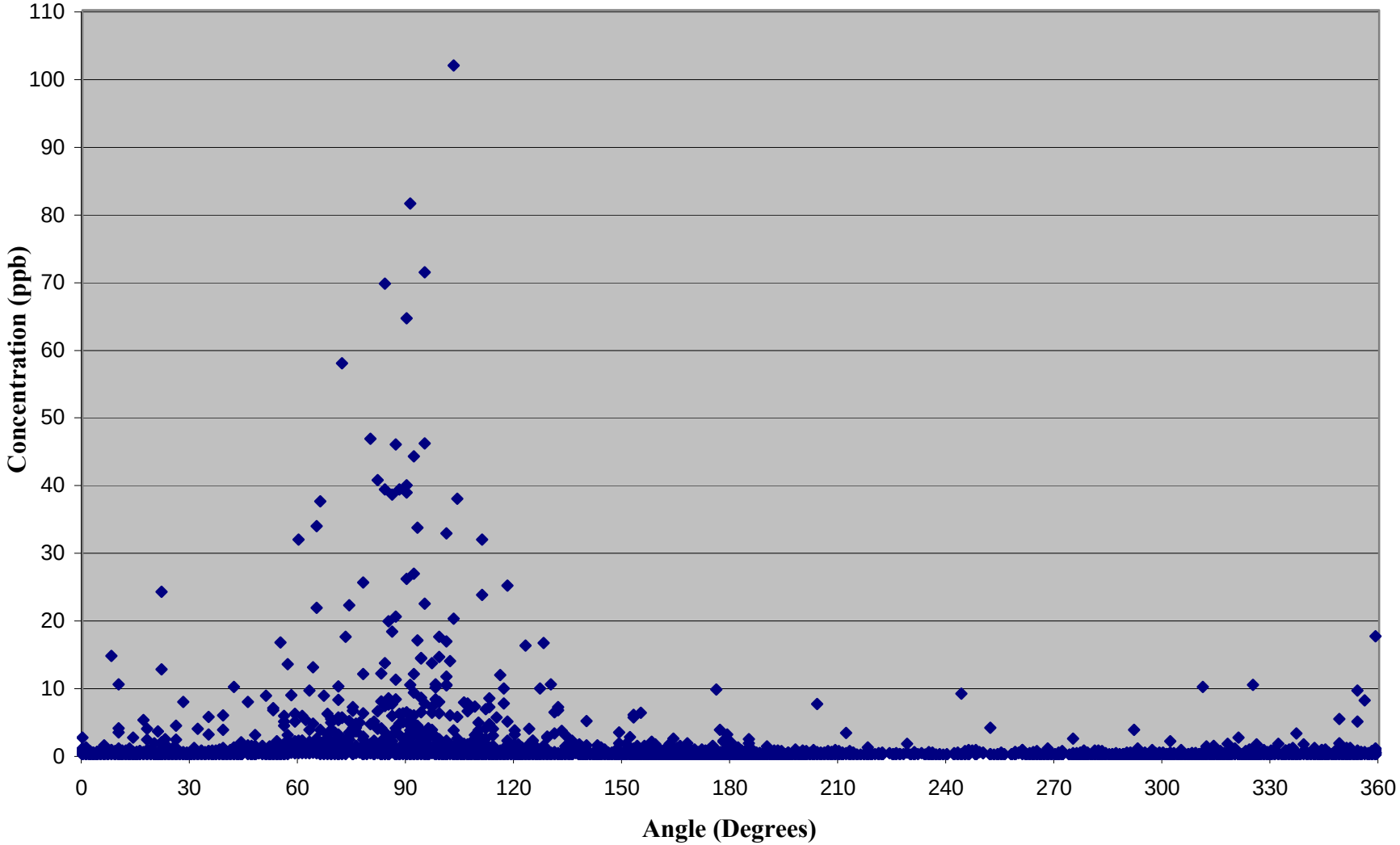
Maximum Value/Site Name	Atlantic	Clarion	Malcom	Sioux Center	Viking Lake	Williams	Woodbine
1	651	1182	399	358	143	1104	697
2	424	950	364	345	76	819	548
3	419	898	335	321	68	744	542
4	379	893	323	320	61	672	481
5	368	859	267	315	54	662	453
6	365	757	265	314	48	618	443
7	319	732	255	309	47	611	419
8	317	730	241	289	41	579	413
9	313	696	234	284	40	576	403
10	306	691	194	277	39	559	397

Atlantic Monitoring Site

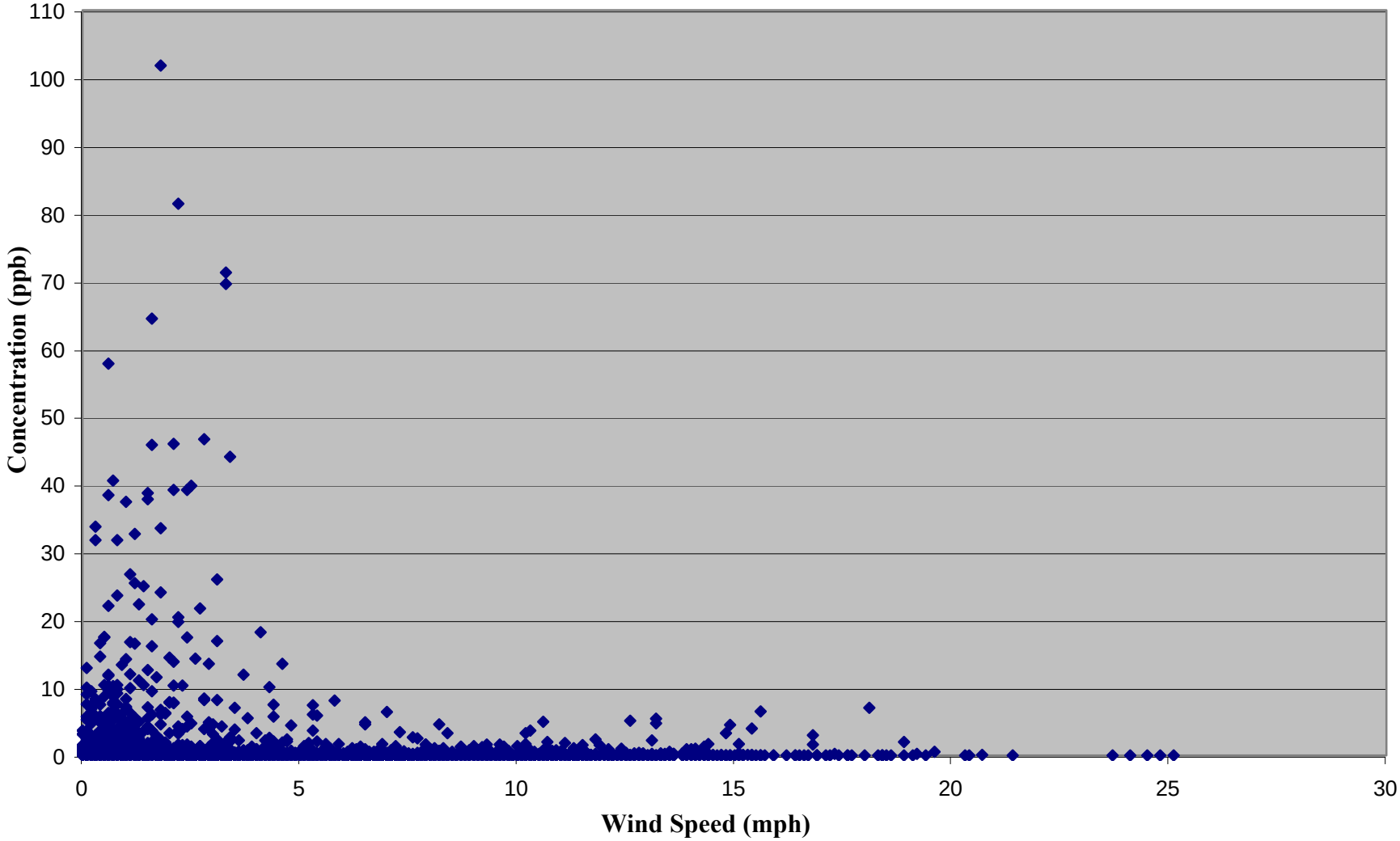


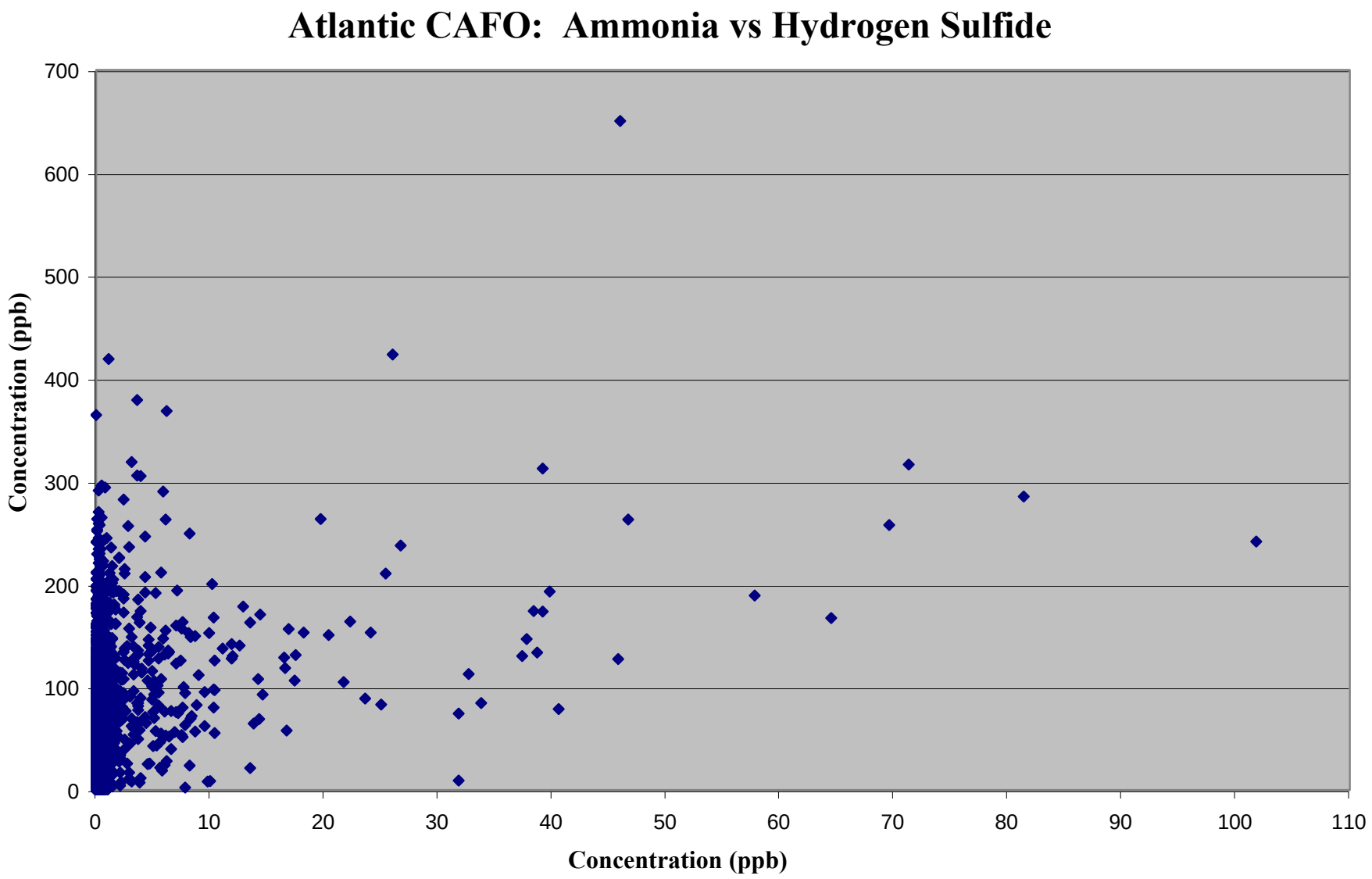

Atlantic CAFO: Hydrogen Sulfide vs Time
Concentration (ppb)
120
110
100
90
80
70
60
50
40
30
20
10
0
1/1/2003
2/1/2003
3/1/2003
4/1/2003
5/1/2003
6/1/2003
7/1/2003
8/1/2003
9/1/2003
10/1/2003
11/1/2003
12/1/2003
Date

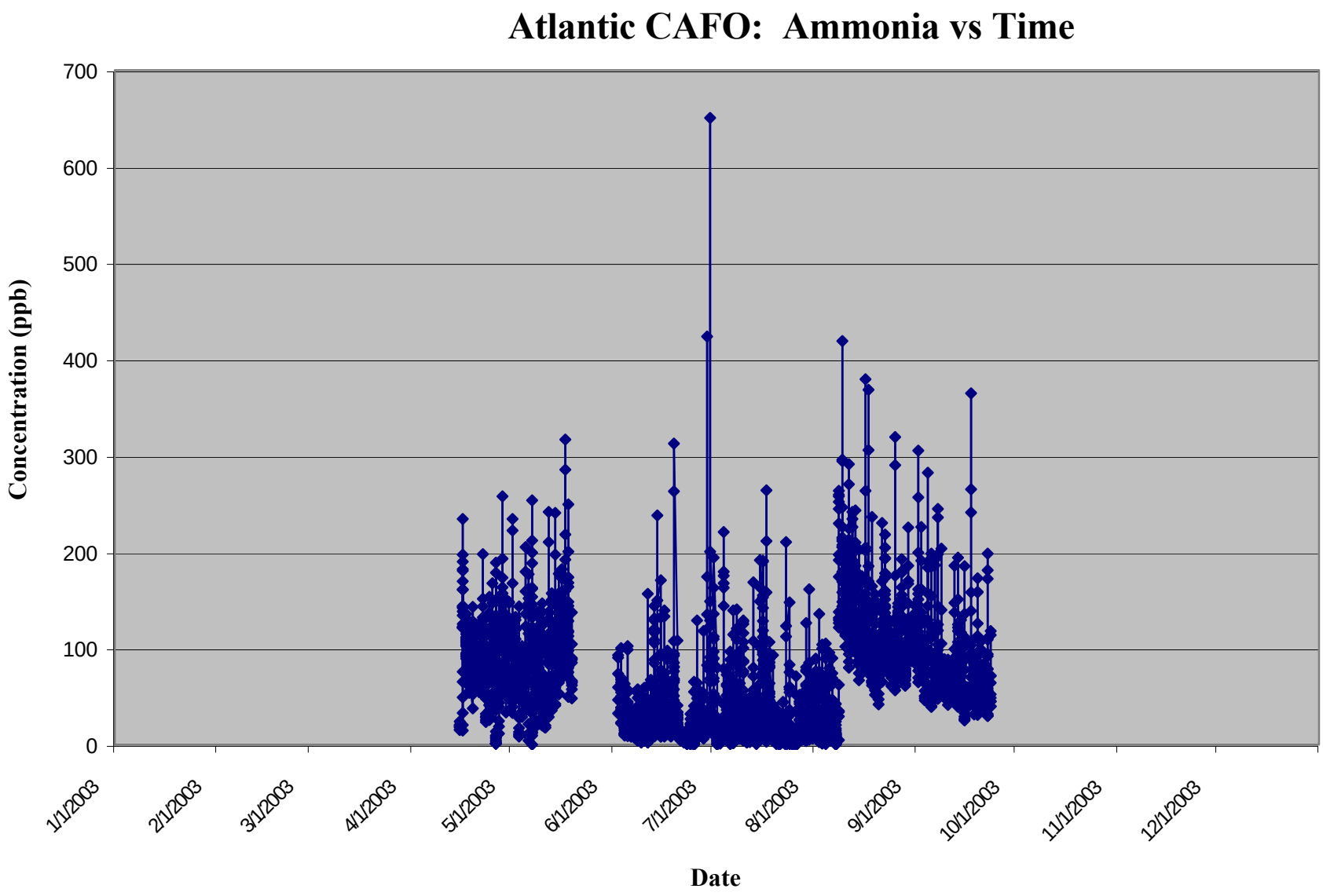
Atlantic CAFO-Hydrogen Sulfide vs Wind Direction



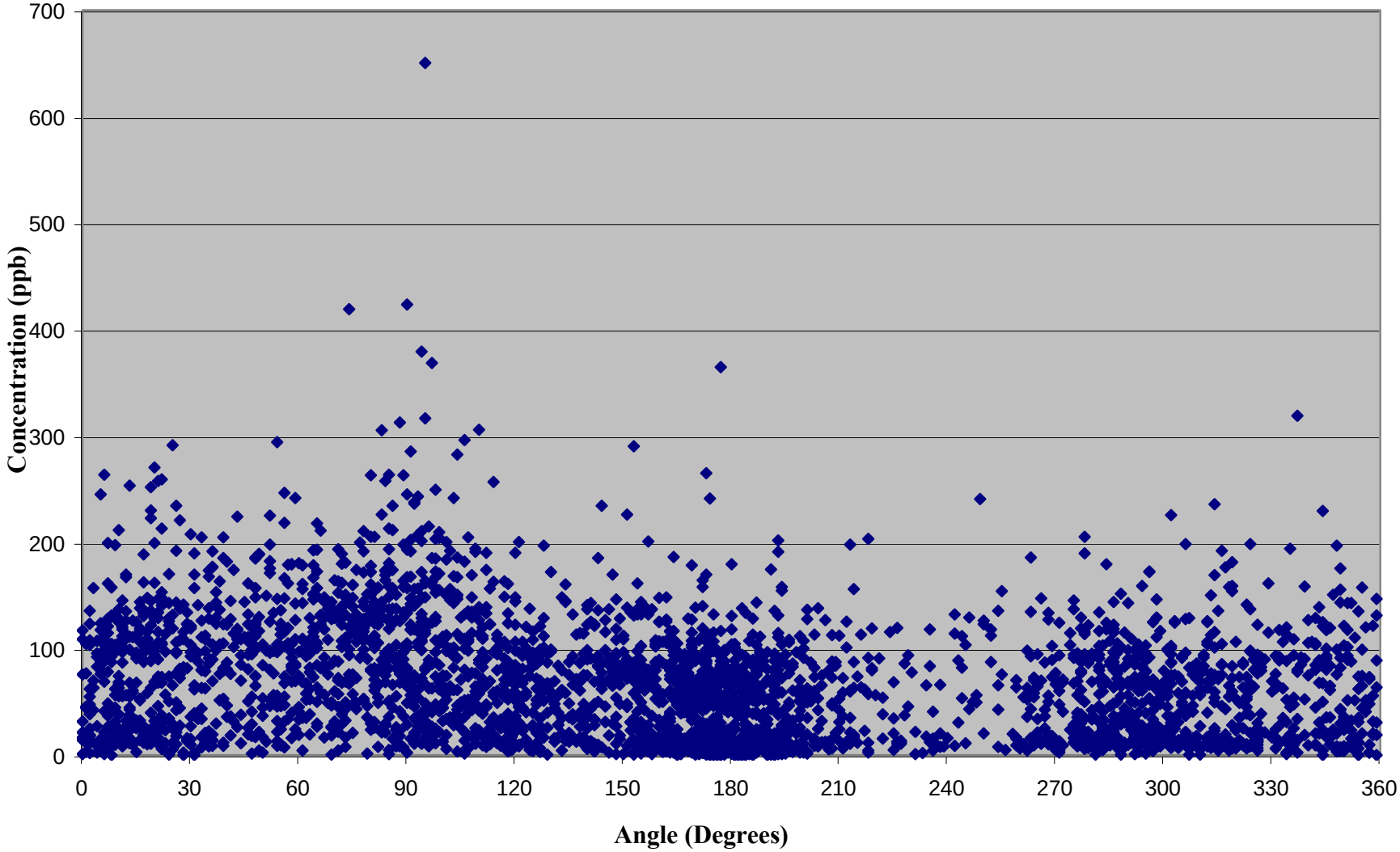
Atlantic CAFO: Hydrogen Sulfide vs Wind Speed



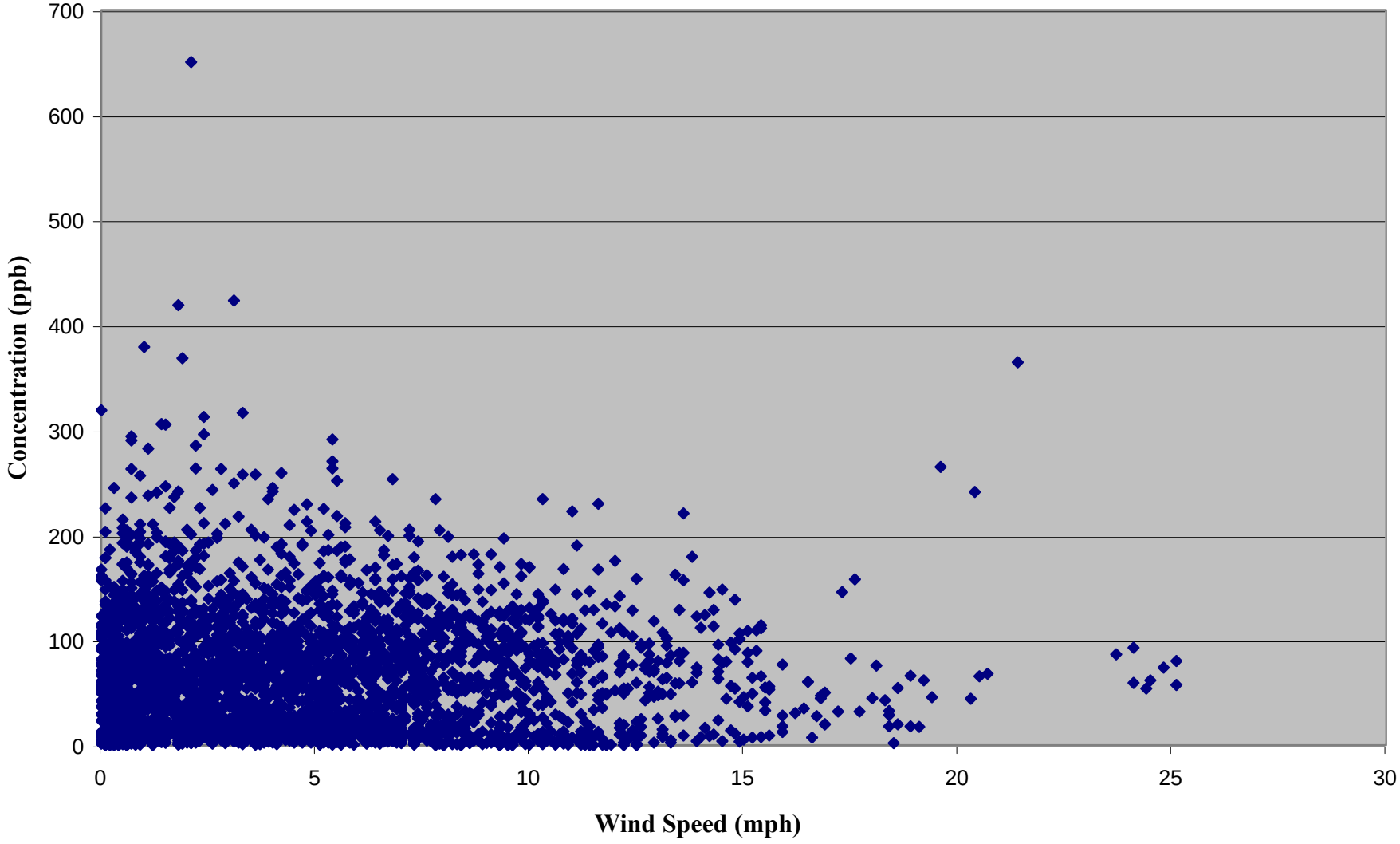

Atlantic CAFO: Ammonia vs Hydrogen Sulfide
Concentration (ppb)
700
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
110
Concentration (ppb)


Atlantic CAFO: Ammonia vs Time
Concentration (ppb)
700
600
500
400
300
200
100
0
1/1/2003
2/1/2003
3/1/2003
4/1/2003
5/1/2003
6/1/2003
7/1/2003
8/1/2003
9/1/2003
10/1/2003
11/1/2003
12/1/2003
Date

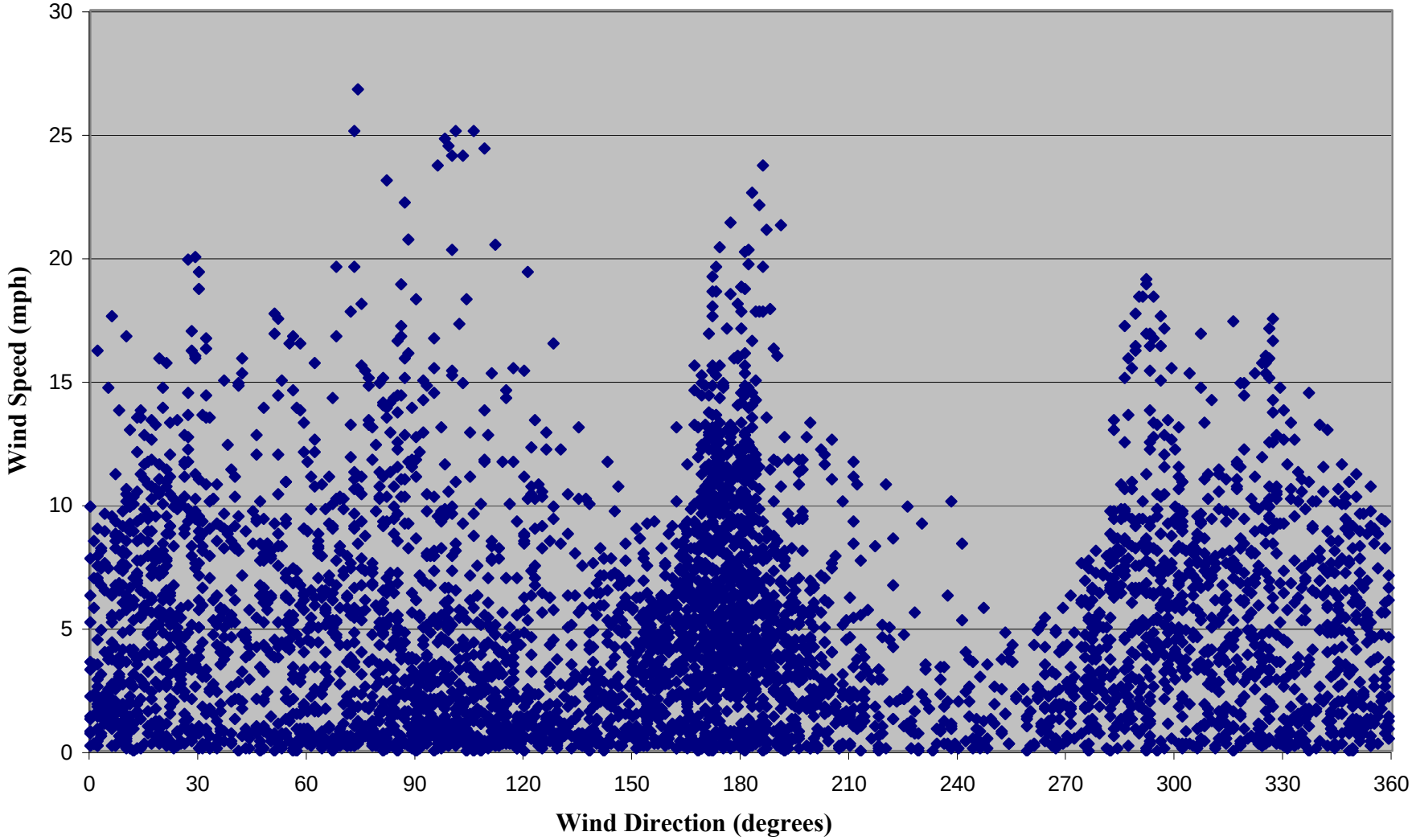
Atlantic CAFO: Ammonia vs Wind Direction

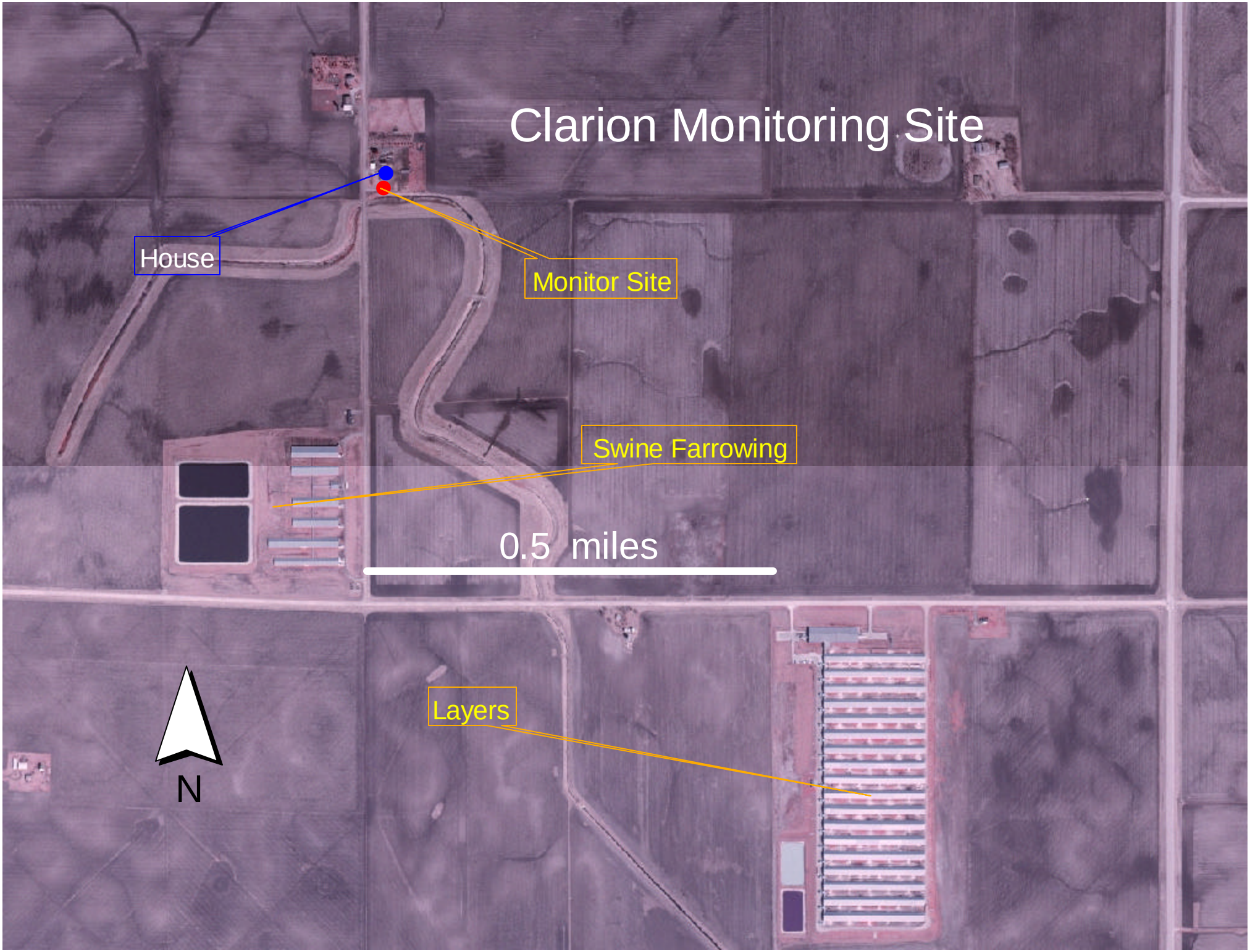


Atlantic CAFO: Ammonia vs Wind Speed

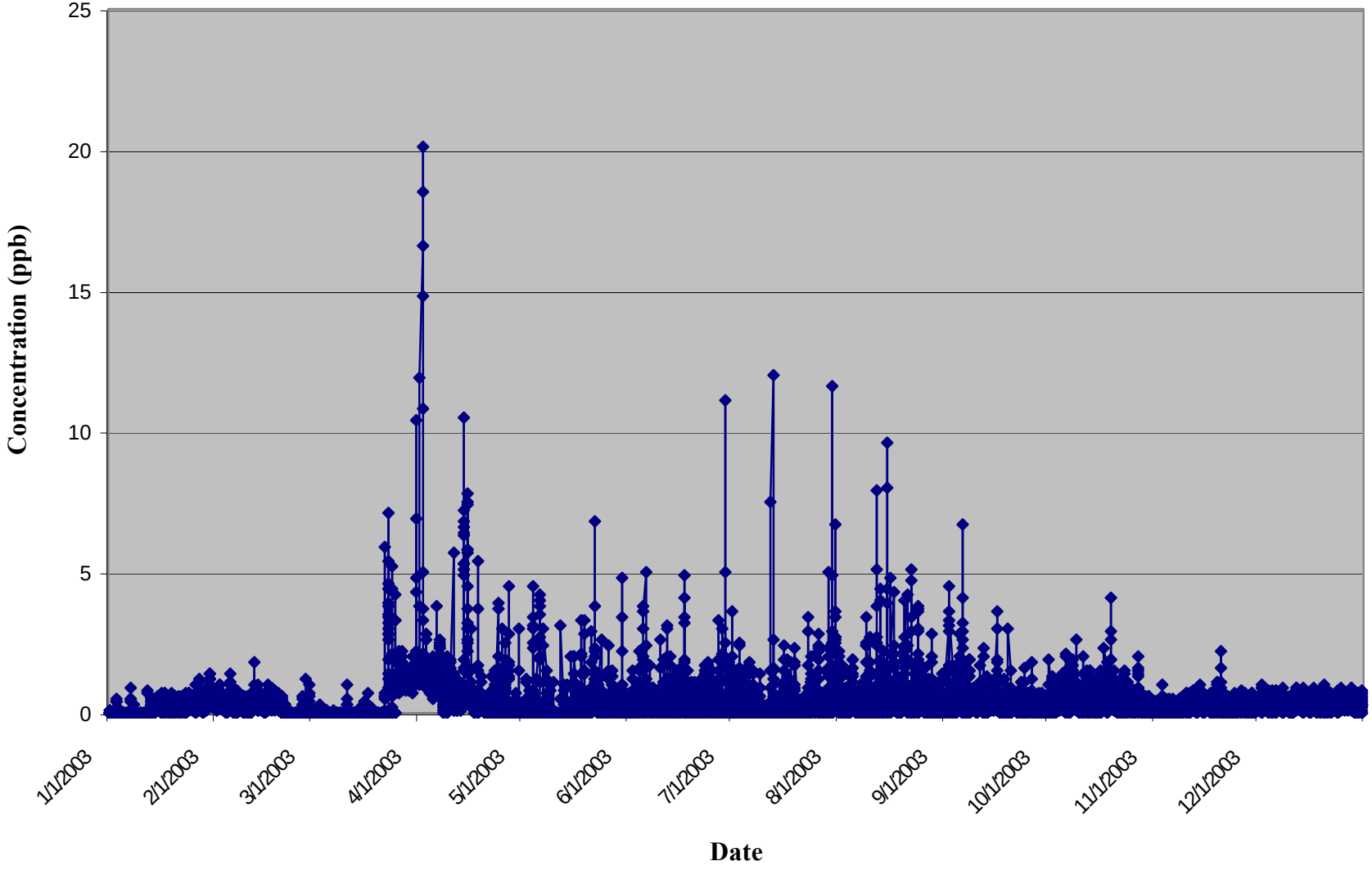


Atlantic CAFO: Wind Speed vs Wind Direction

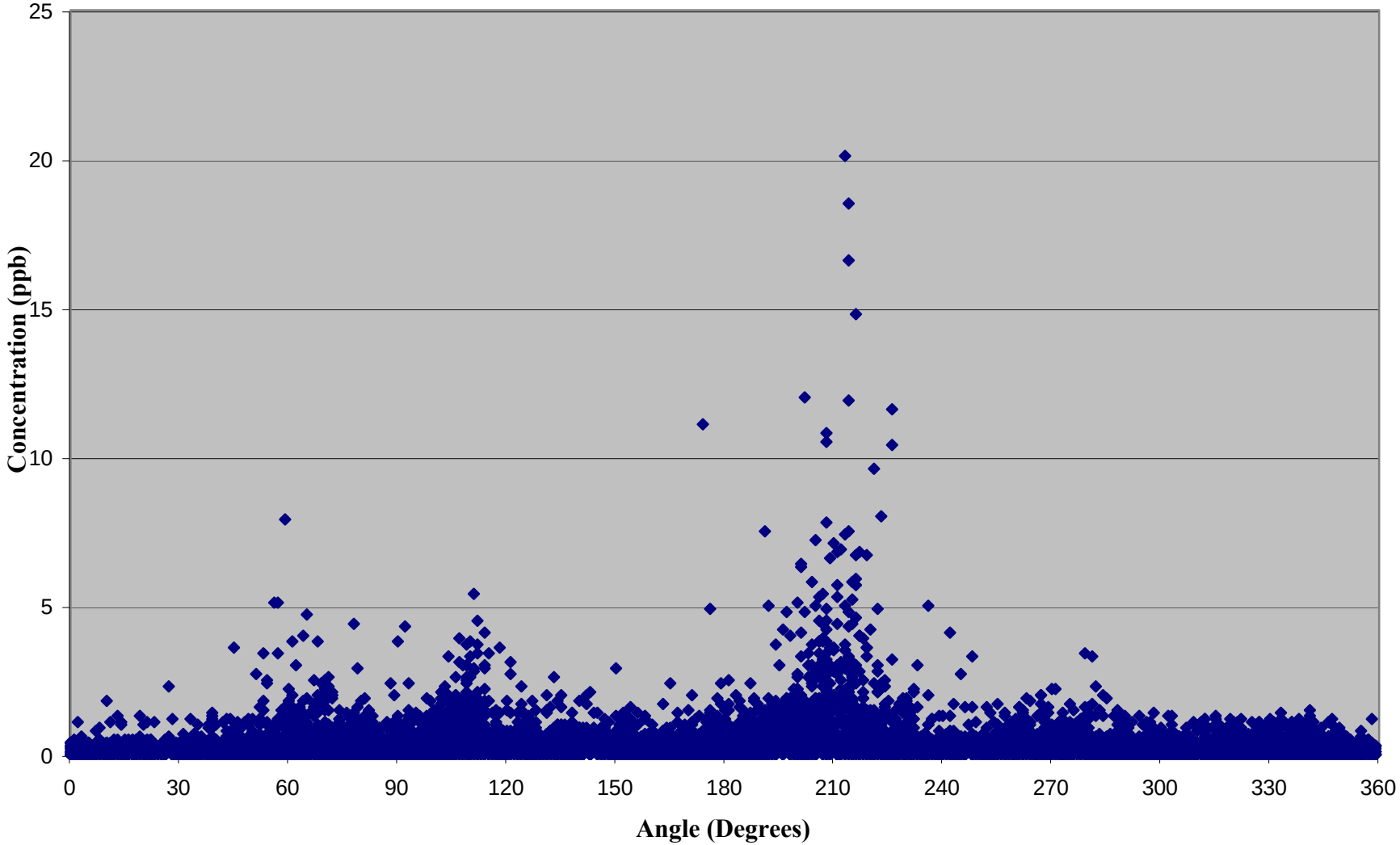



Clarion Monitoring Site
House
Monitor Site
Swine Farrowing
0.5 miles
Layers
N

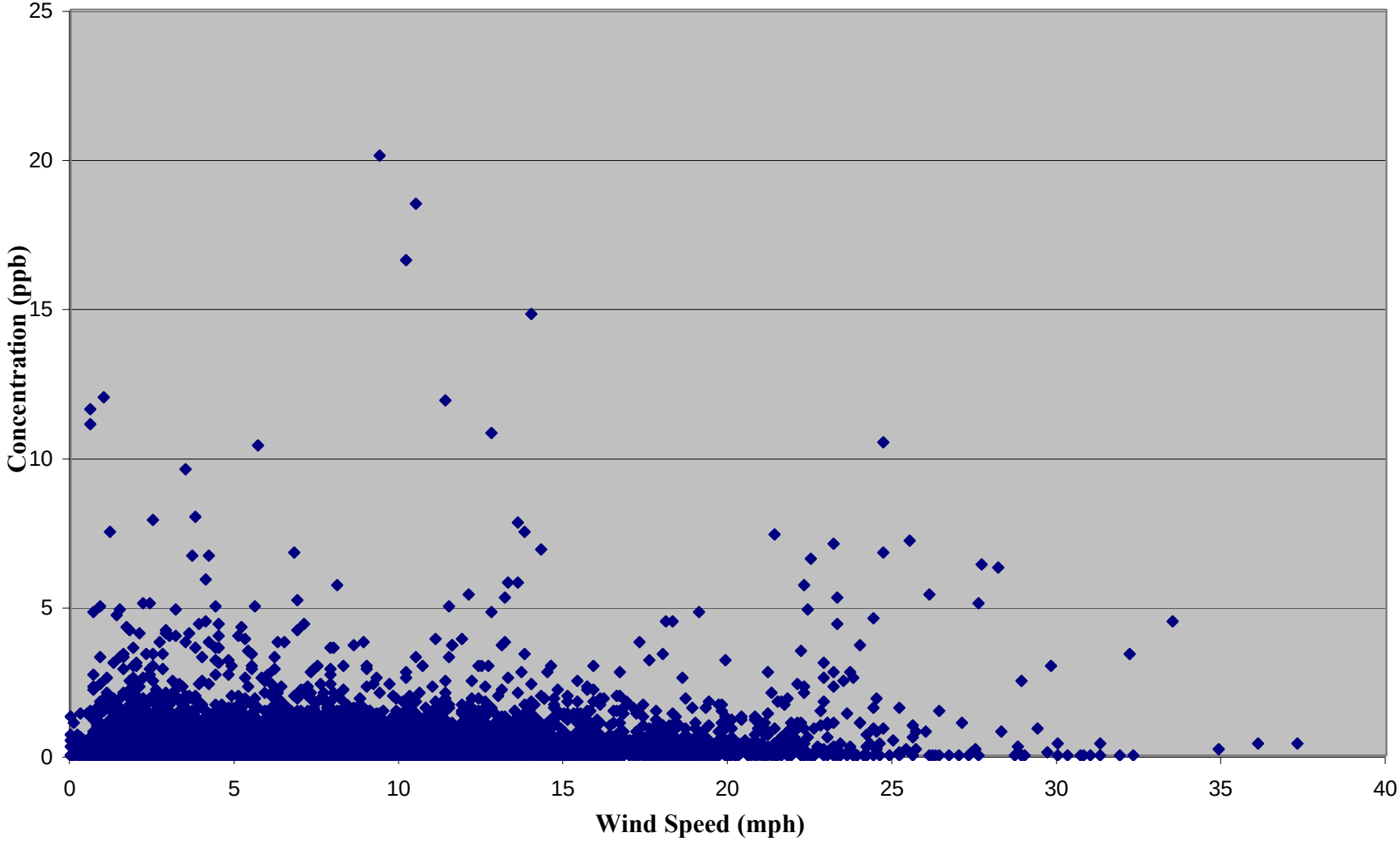
Clarion CAFO: Hydrogen Sulfide vs Time



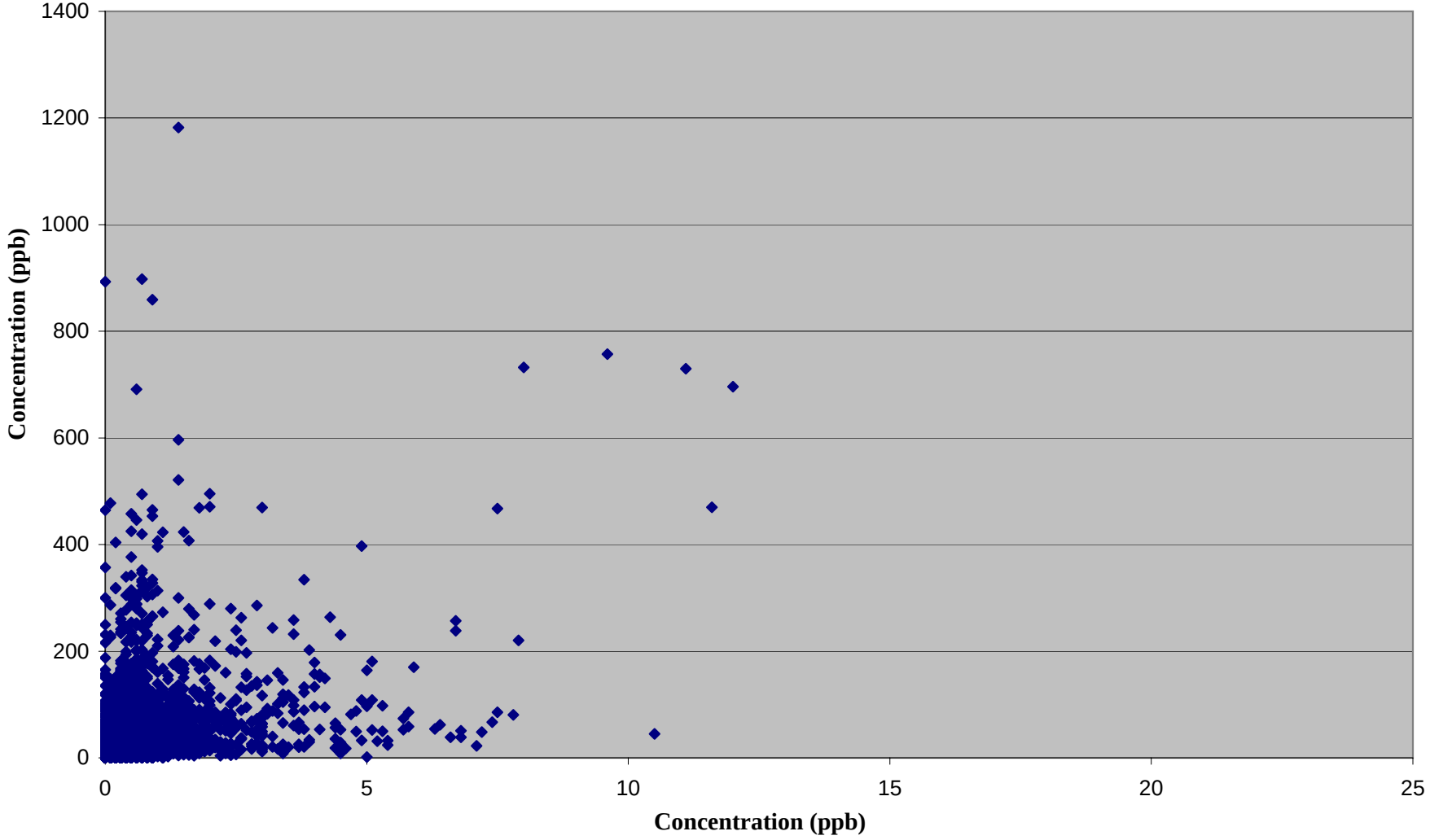
Clarion CAFO-Hydrogen Sulfide vs Wind Direction



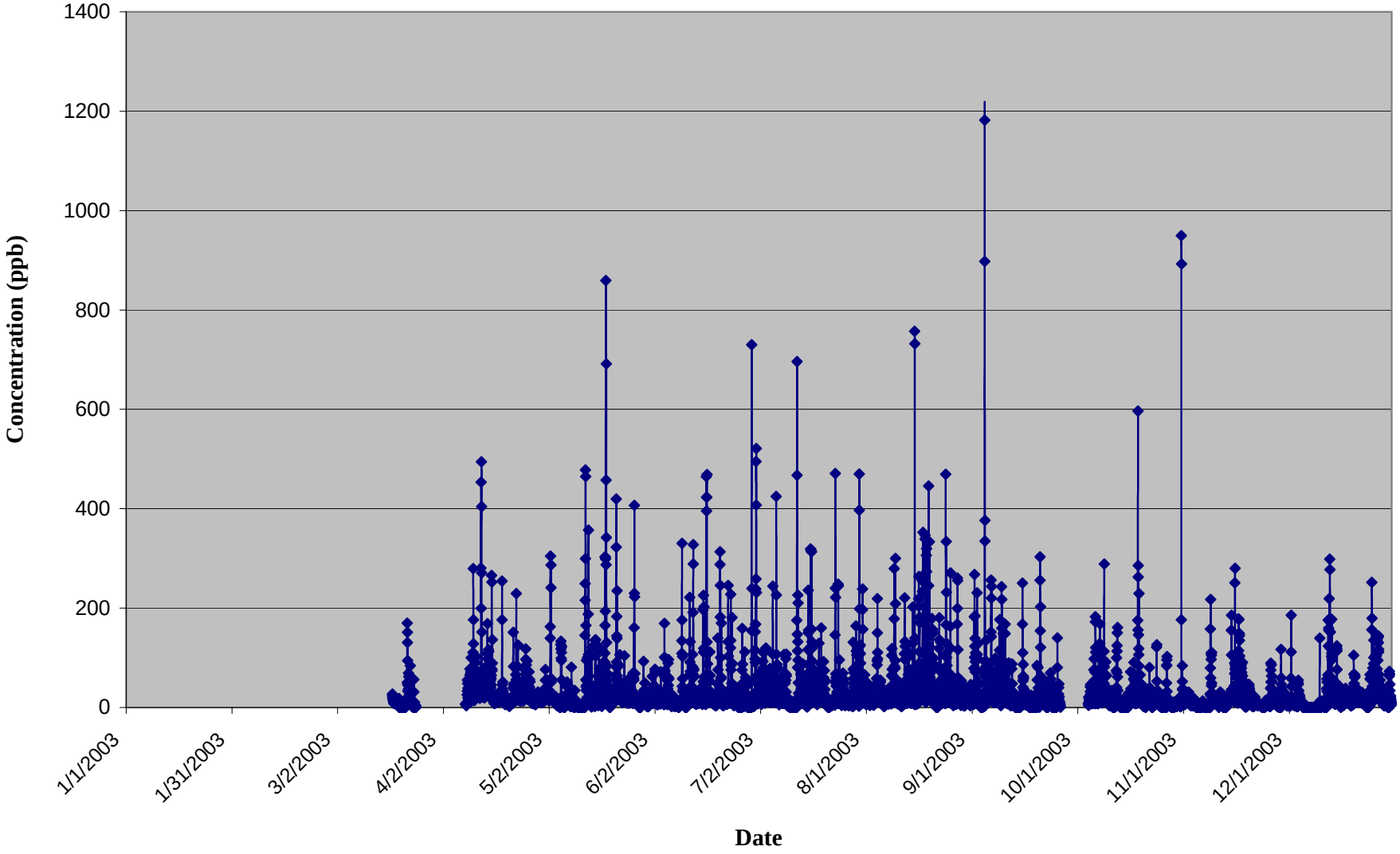
Clarion CAFO: Hydrogen Sulfide vs Wind Speed



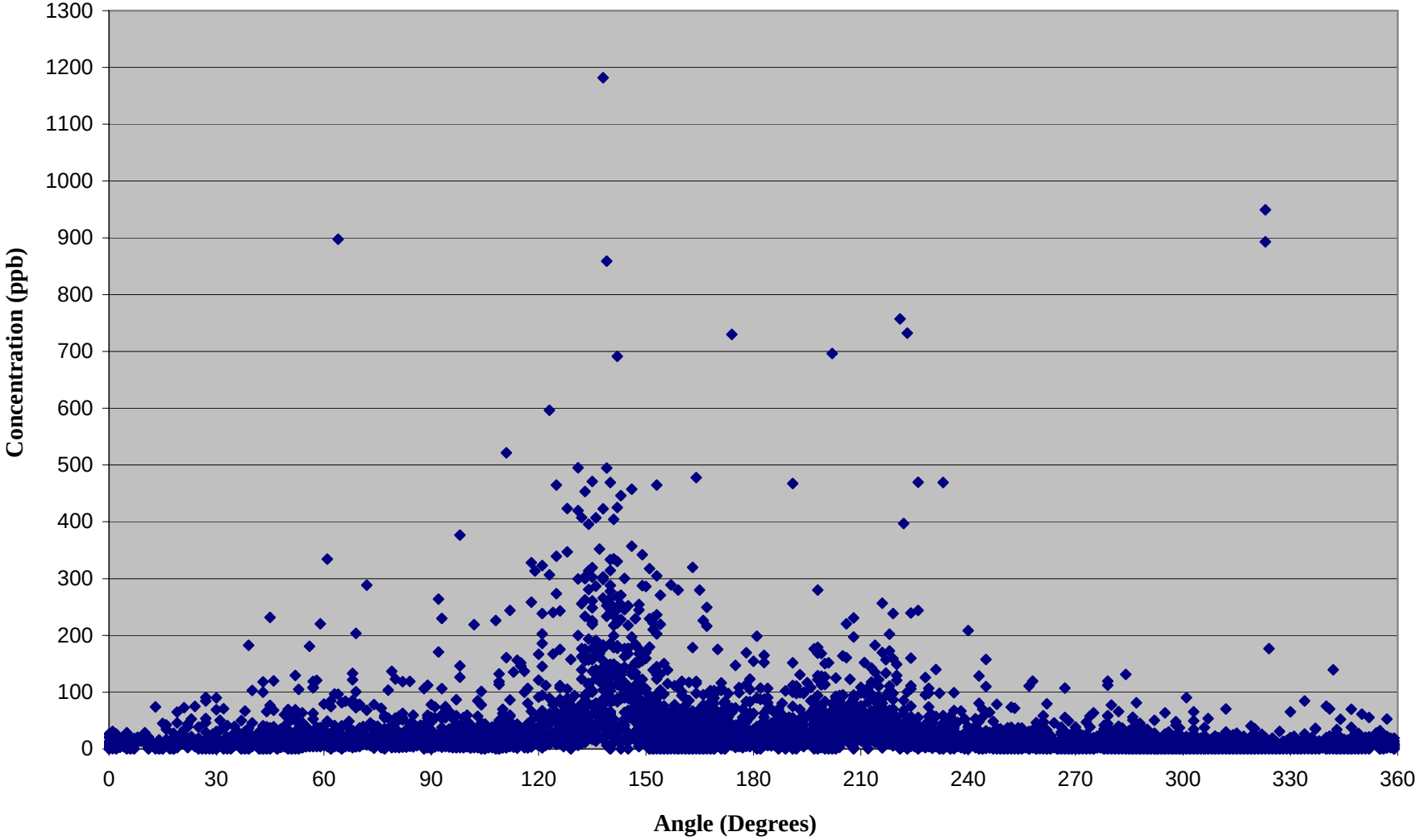
Clarion CAFO: Ammonia vs Hydrogen Sulfide

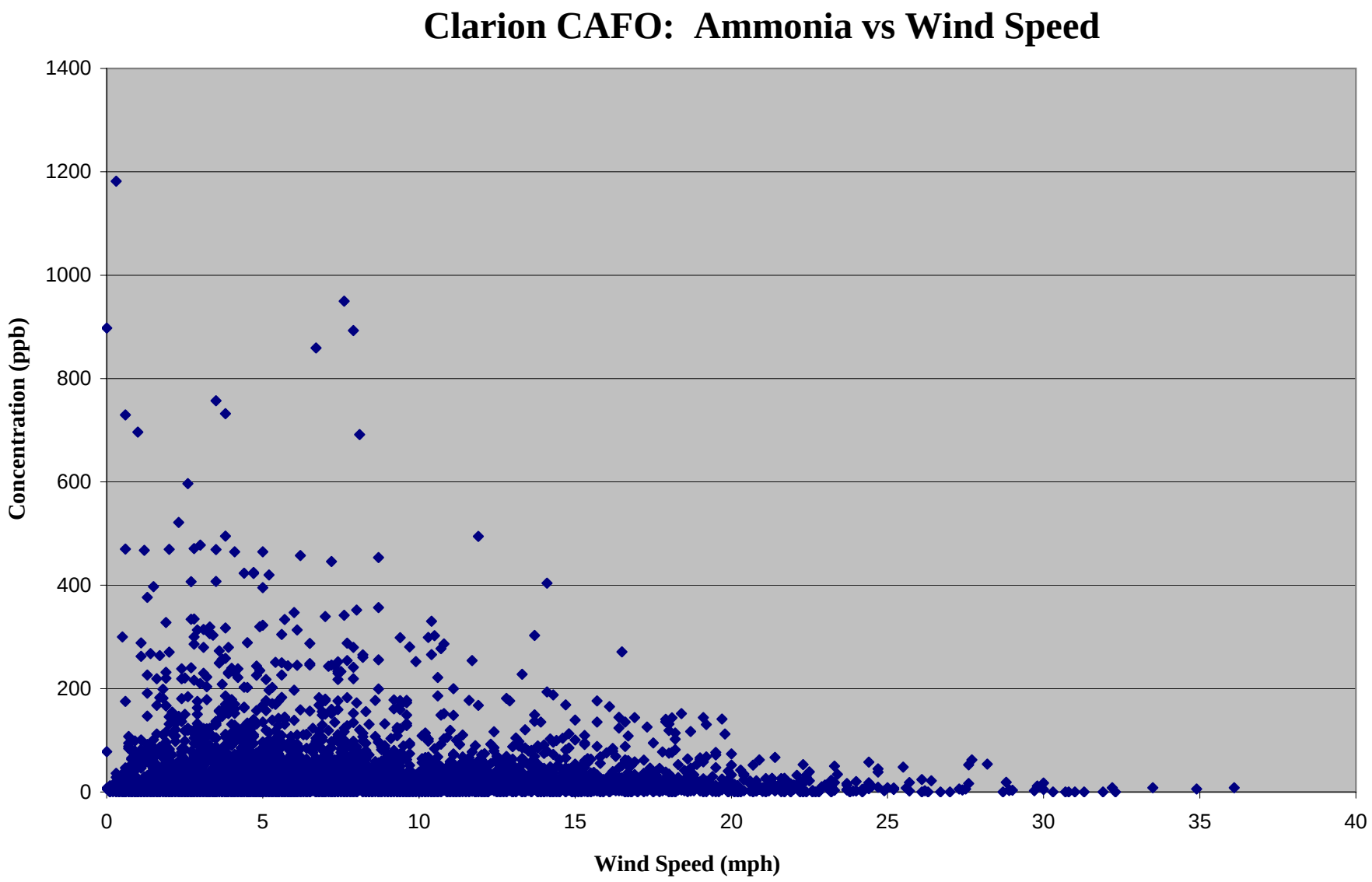


Clarion CAFO: Ammonia vs Time

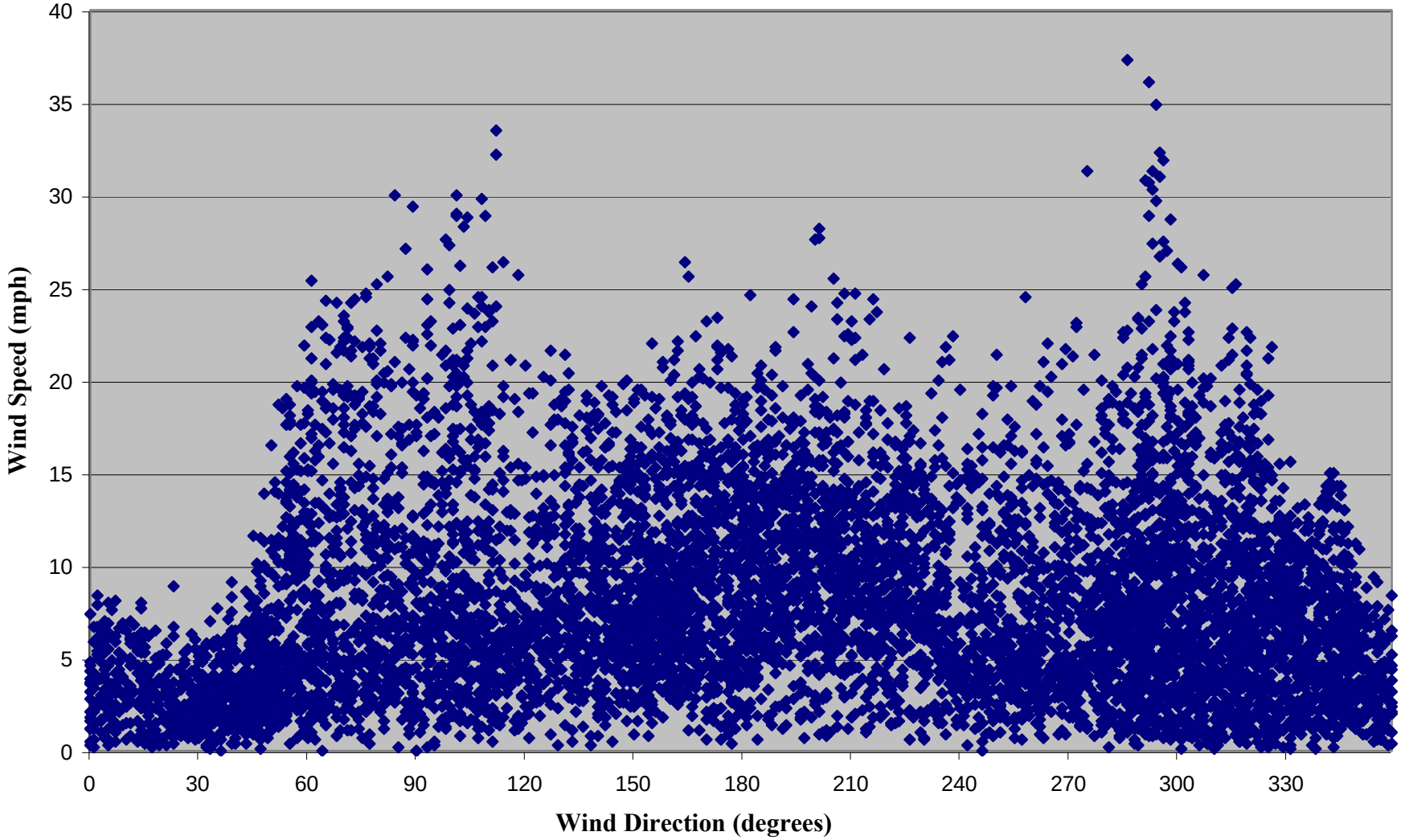


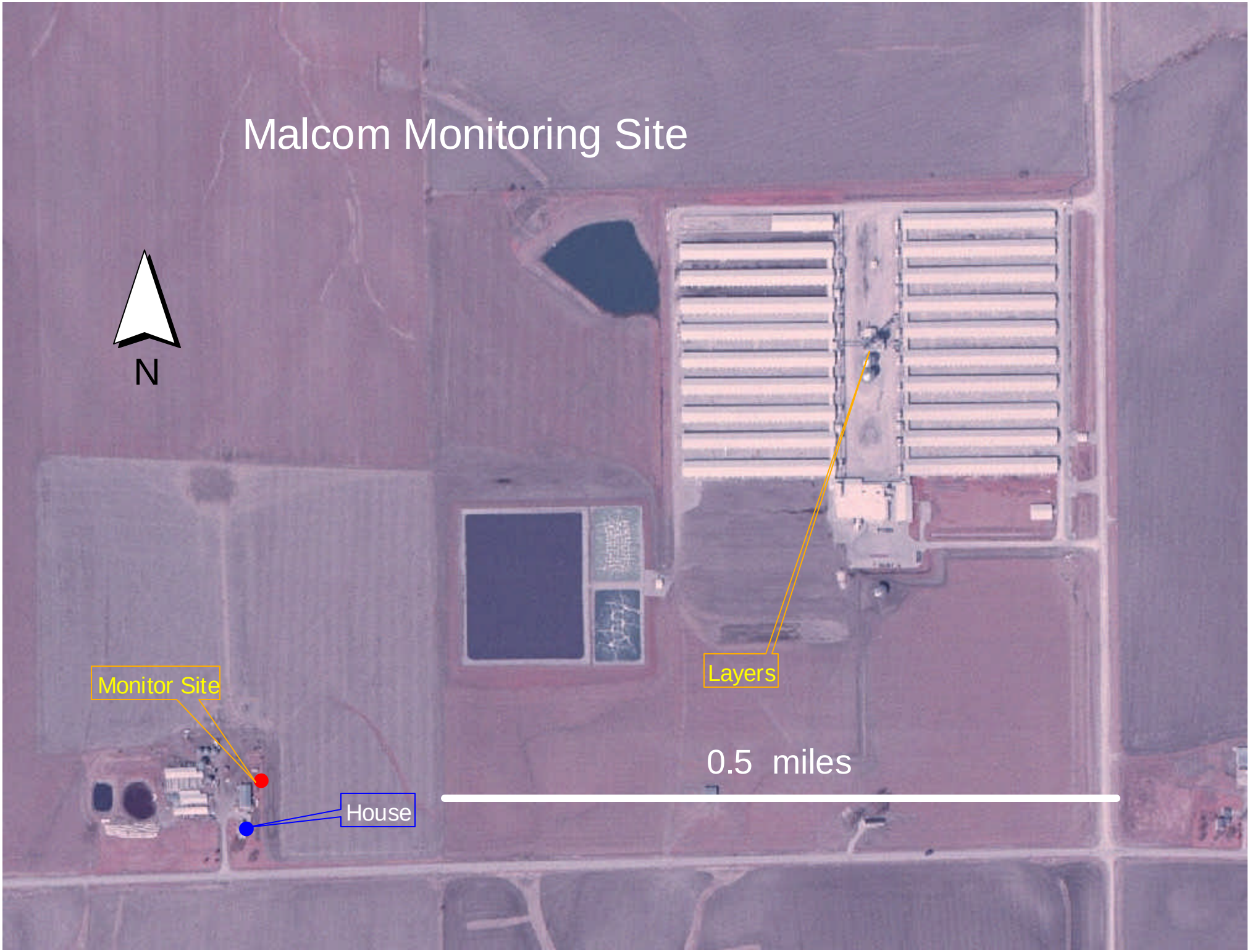
Clarion CAFO: Ammonia vs Wind Direction



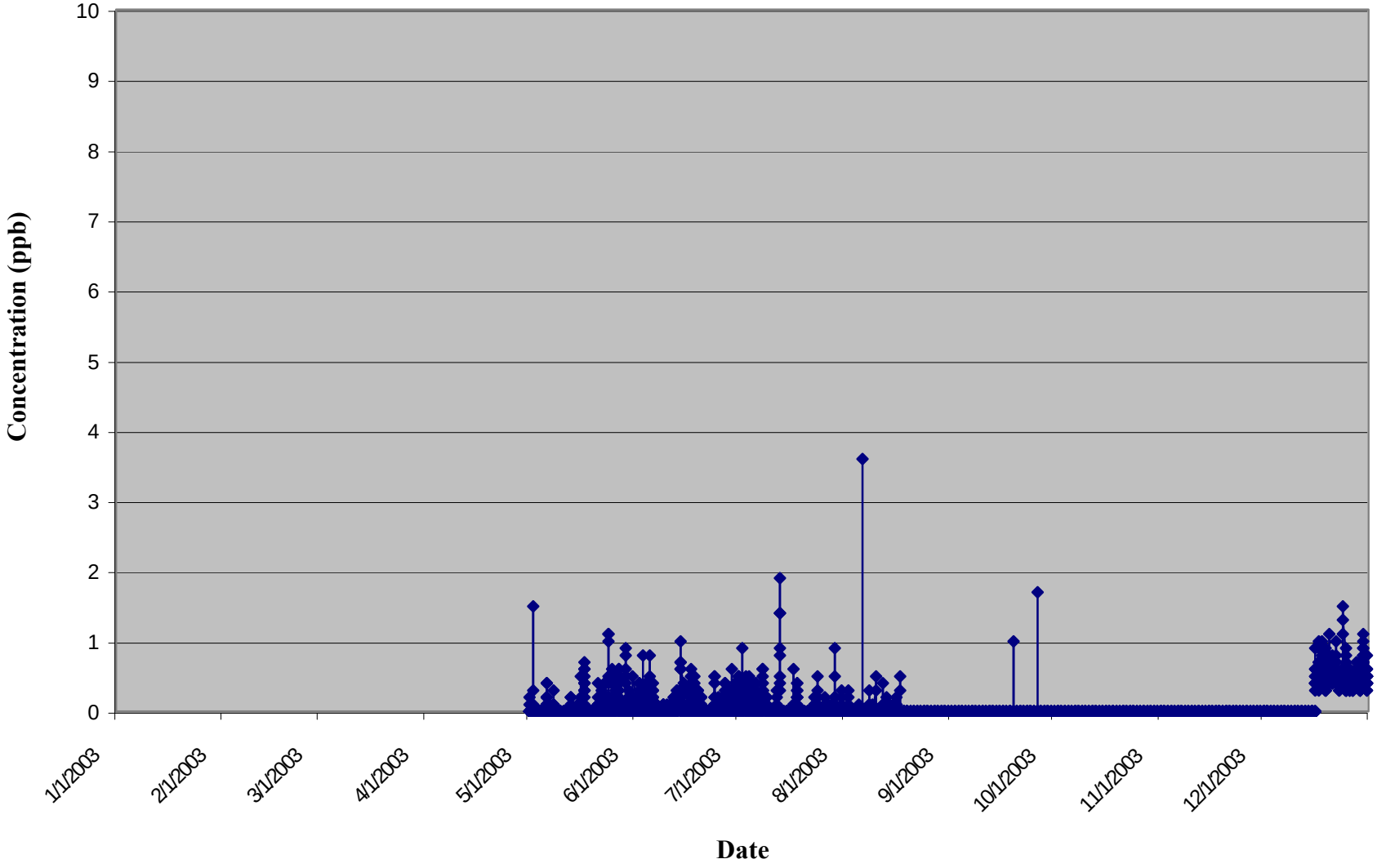

Clarion CAFO: Ammonia vs Wind Speed
Concentration (ppb)
1400
1200
1000
800
600
400
200
0
0
5
10
15
20
25
30
35
40
Wind Speed (mph)

Clarion CAFO: Wind Speed vs Wind Direction

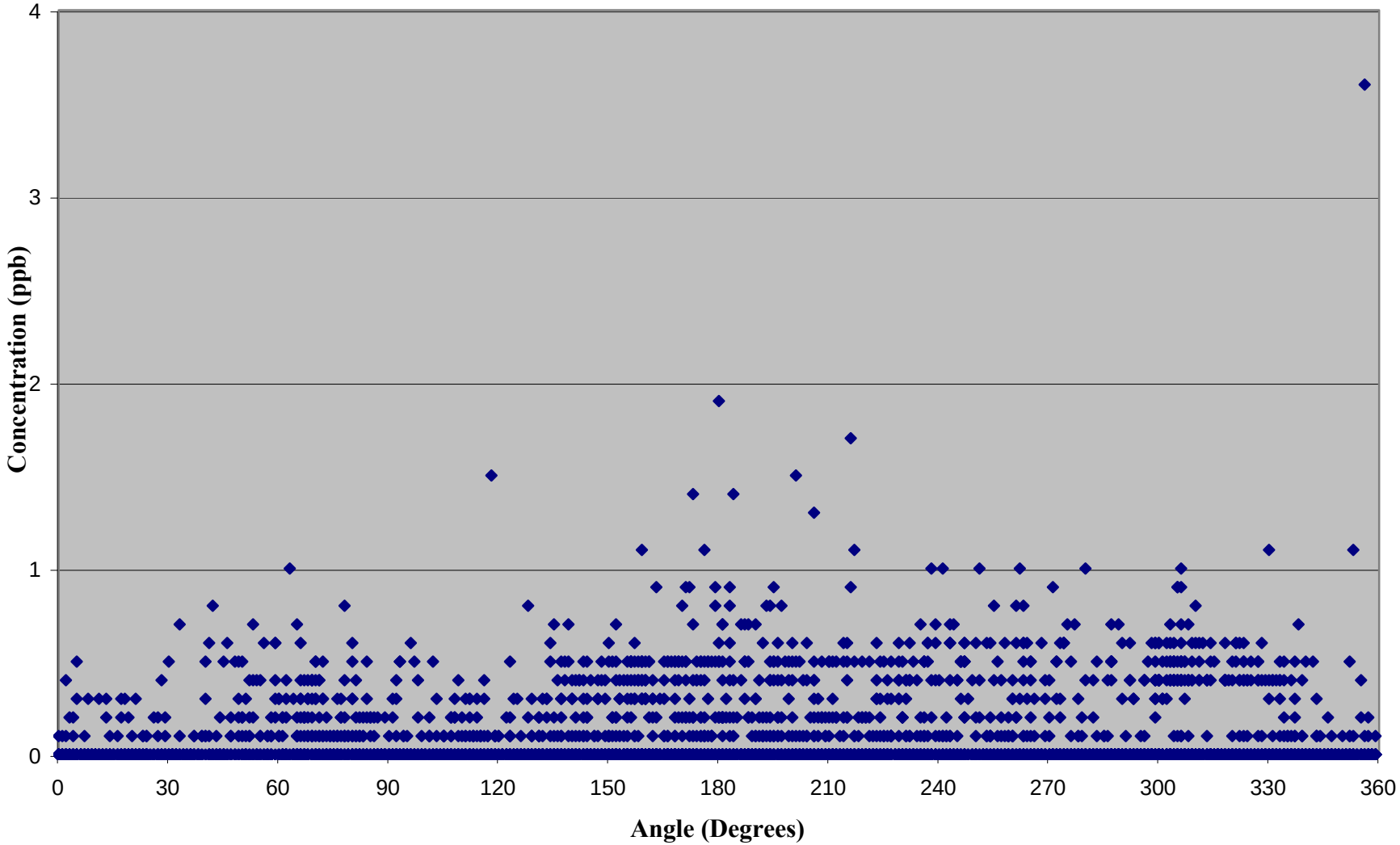



Malcom Monitoring Site
N
Monitor Site
House
Layers
0.5 miles

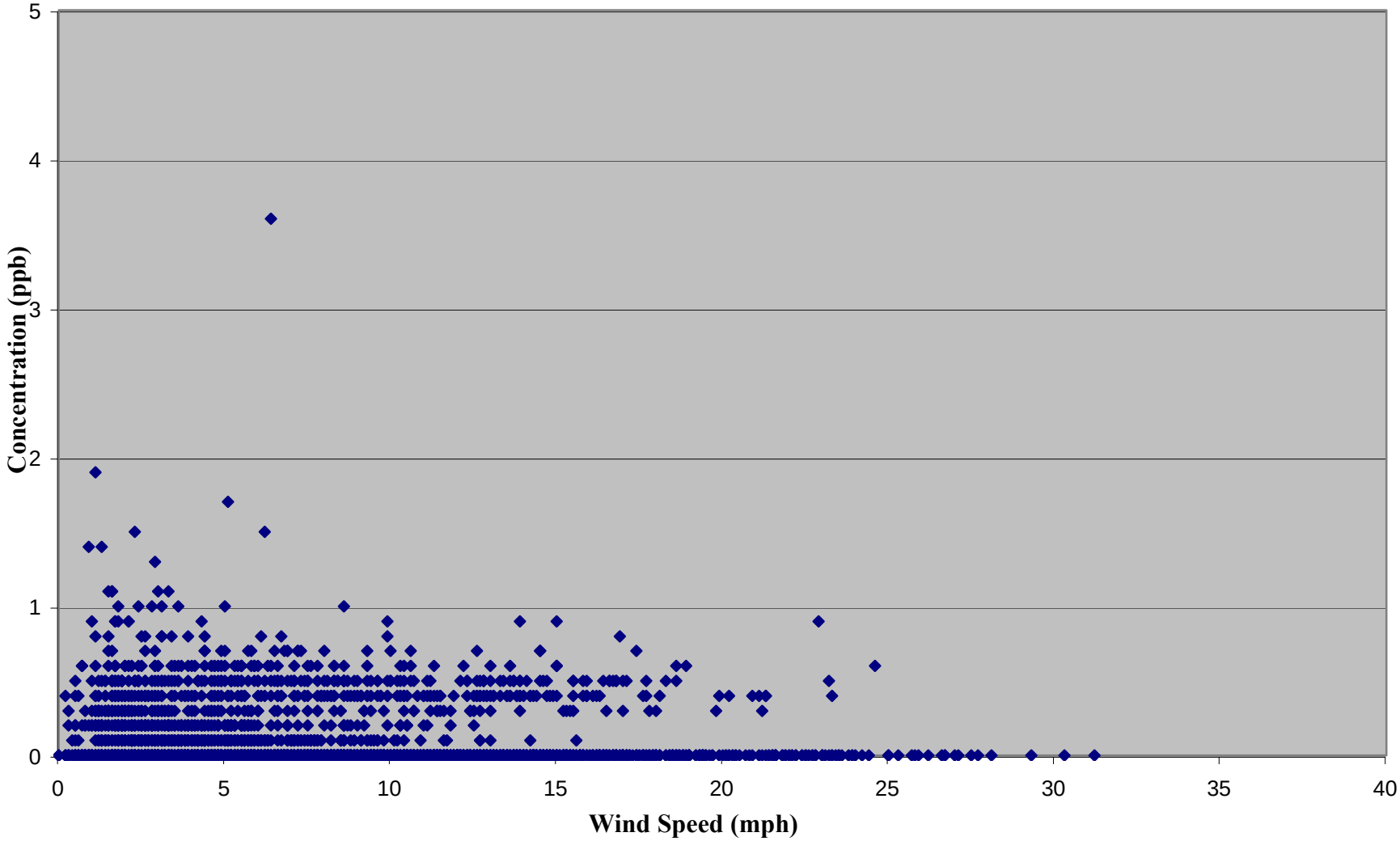
Malcom CAFO: Hydrogen Sulfide vs Time



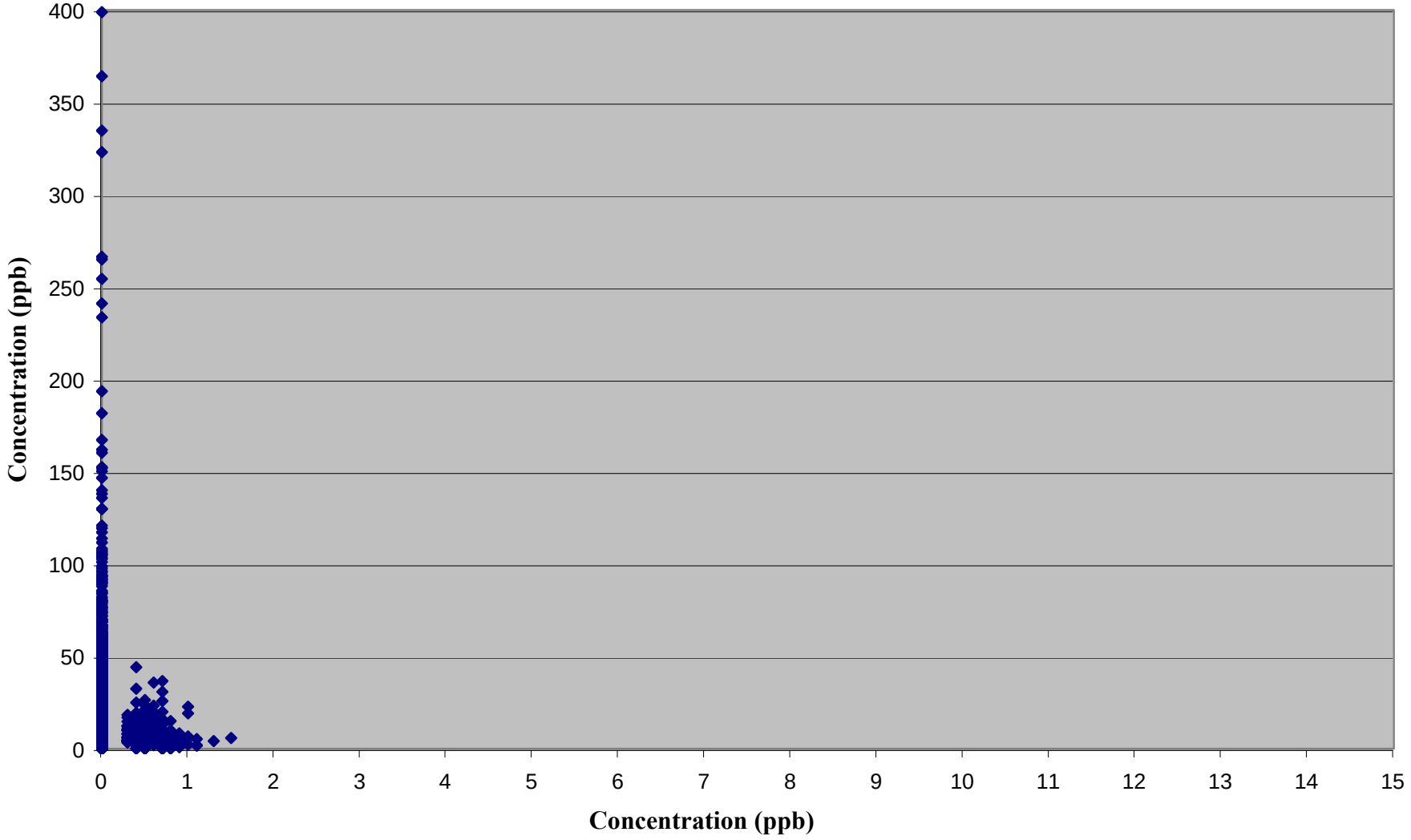
Malcom CAFO-Hydrogen Sulfide vs Wind Direction

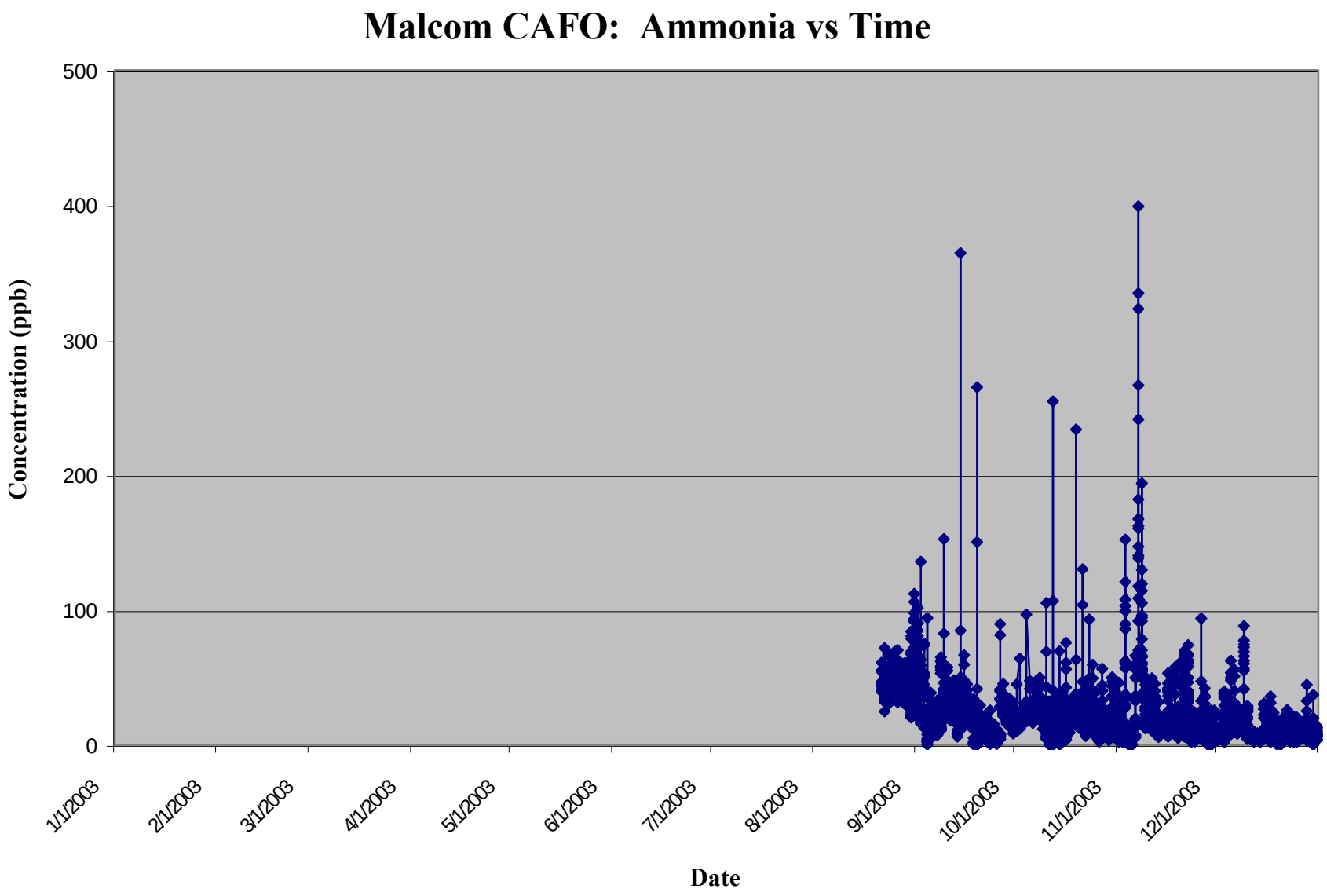


Malcom CAFO: Hydrogen Sulfide vs Wind Speed

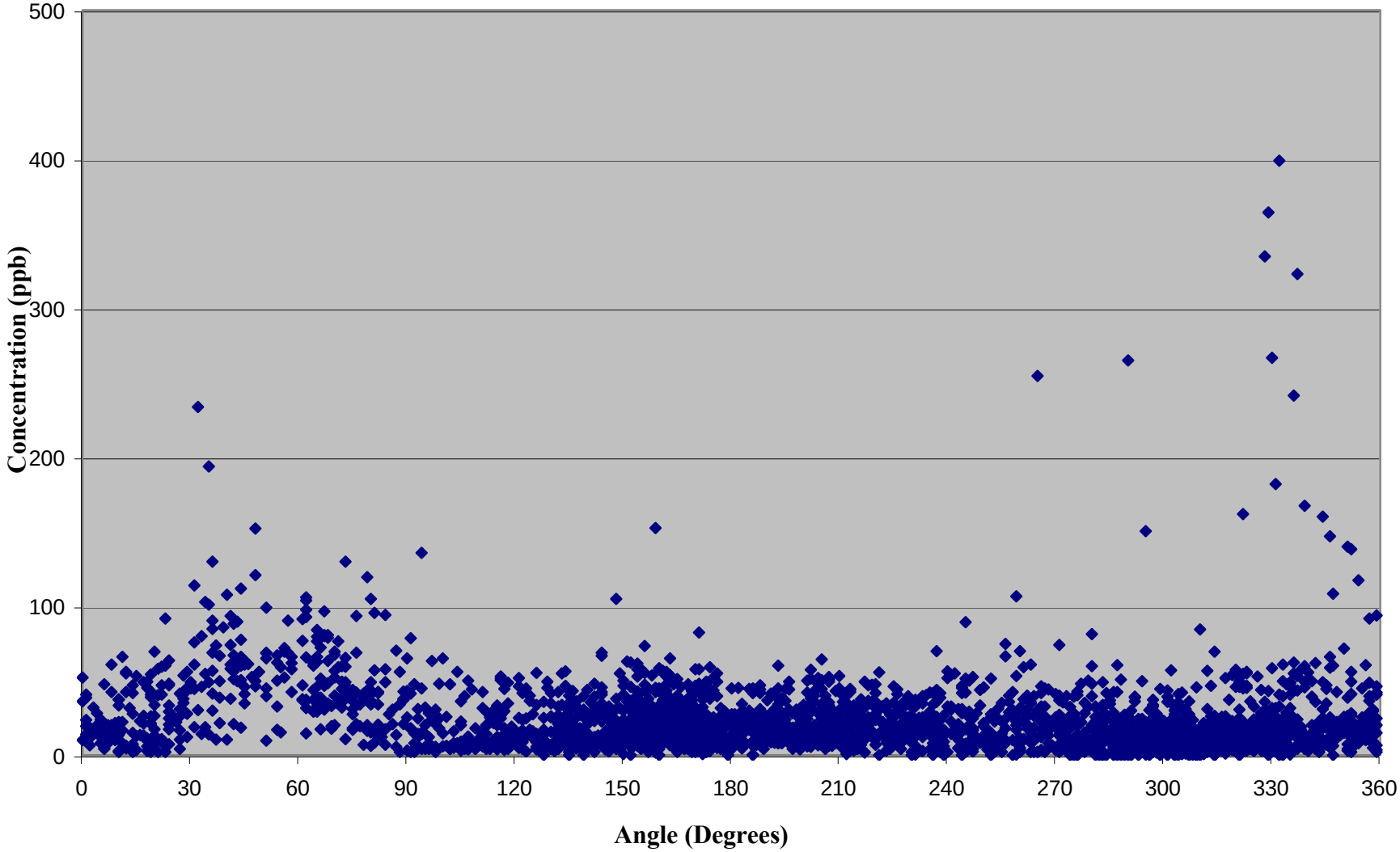


Malcom CAFO: Ammonia vs Hydrogen Sulfide

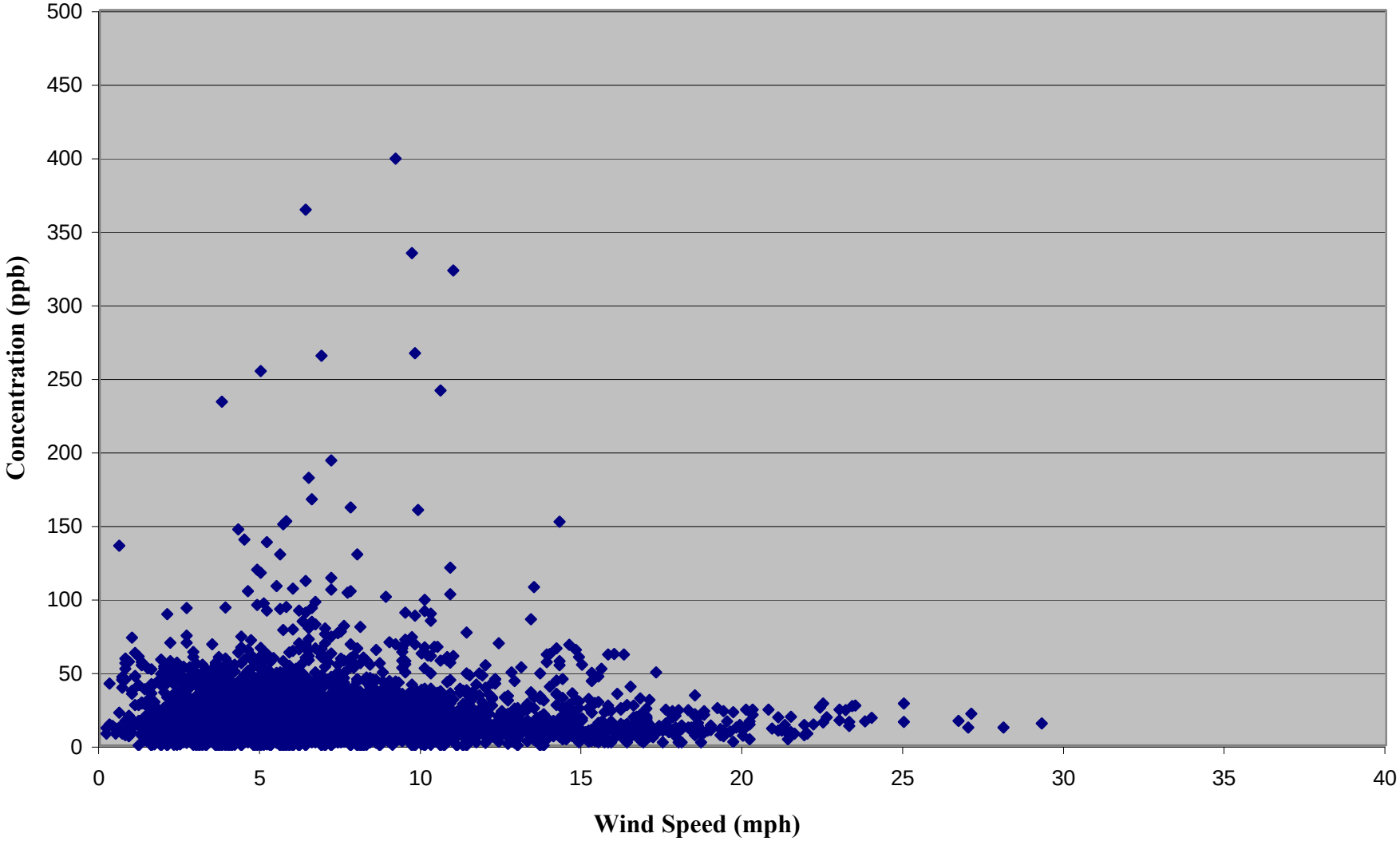



Malcom CAFO: Ammonia vs Time
Concentration (ppb)
500
400
300
200
100
0
1/1/2003
2/1/2003
3/1/2003
4/1/2003
5/1/2003
6/1/2003
7/1/2003
8/1/2003
9/1/2003
10/1/2003
11/1/2003
12/1/2003
Date

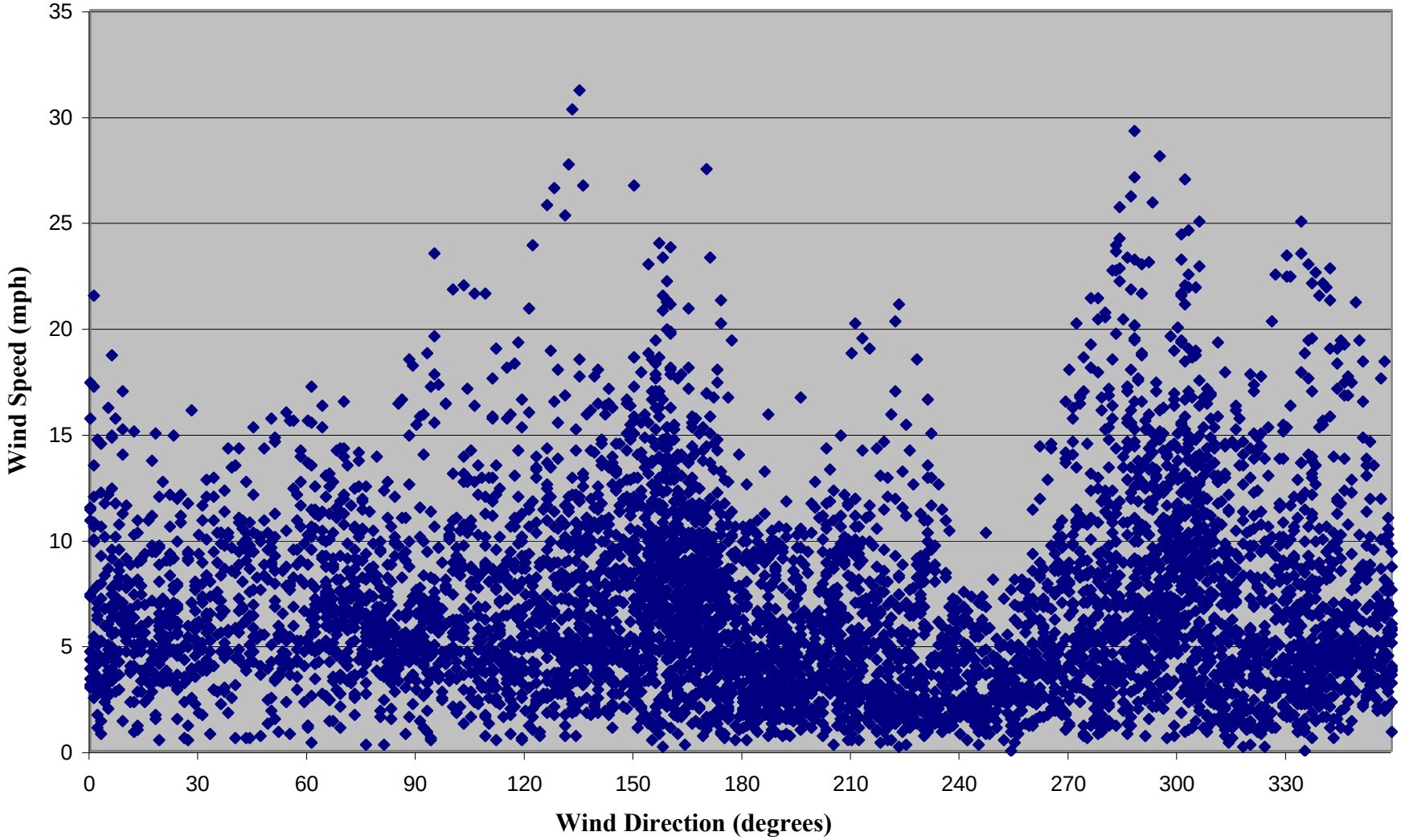
Malcom CAFO: Ammonia vs Wind Direction

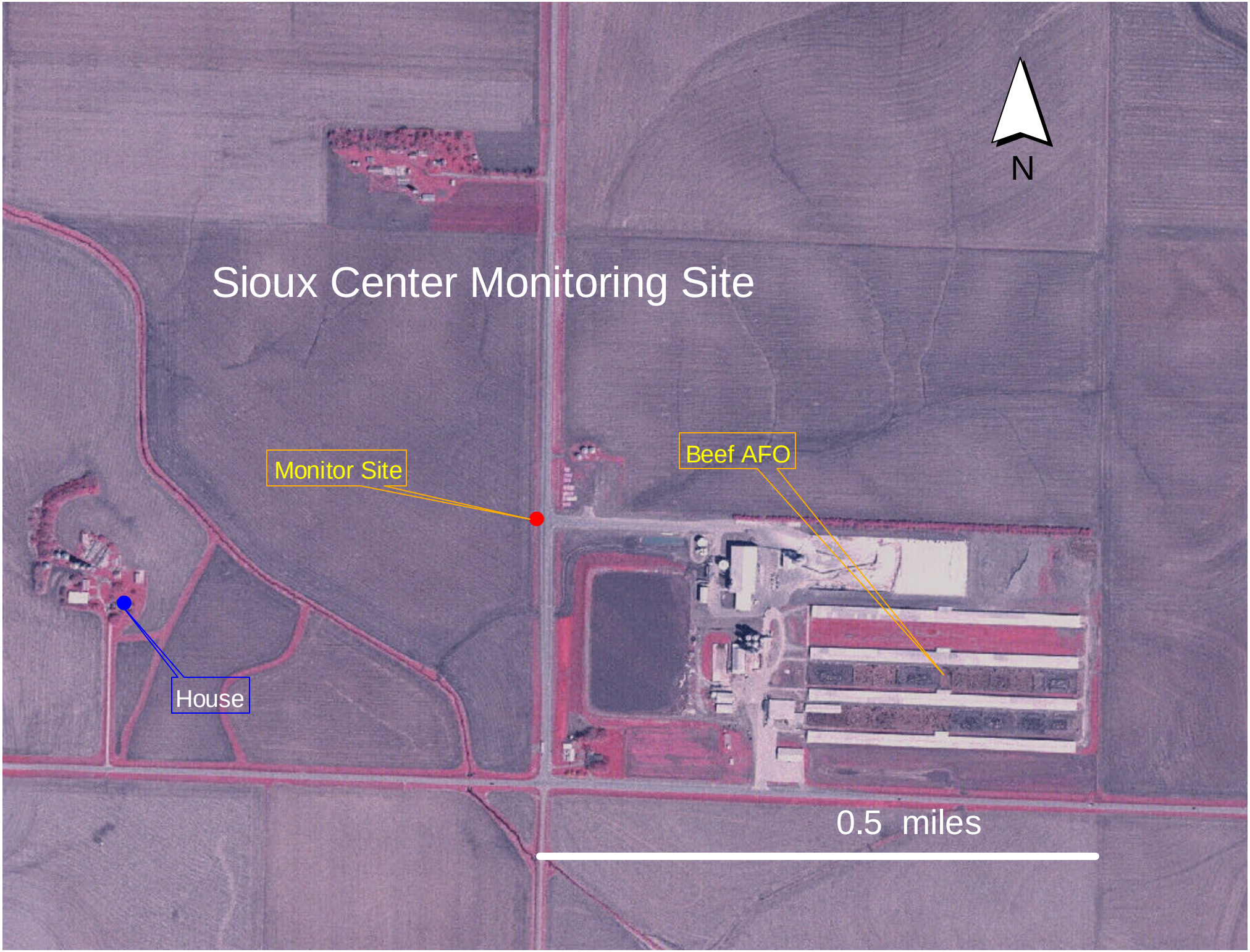


Malcom CAFO: Ammonia vs Wind Speed

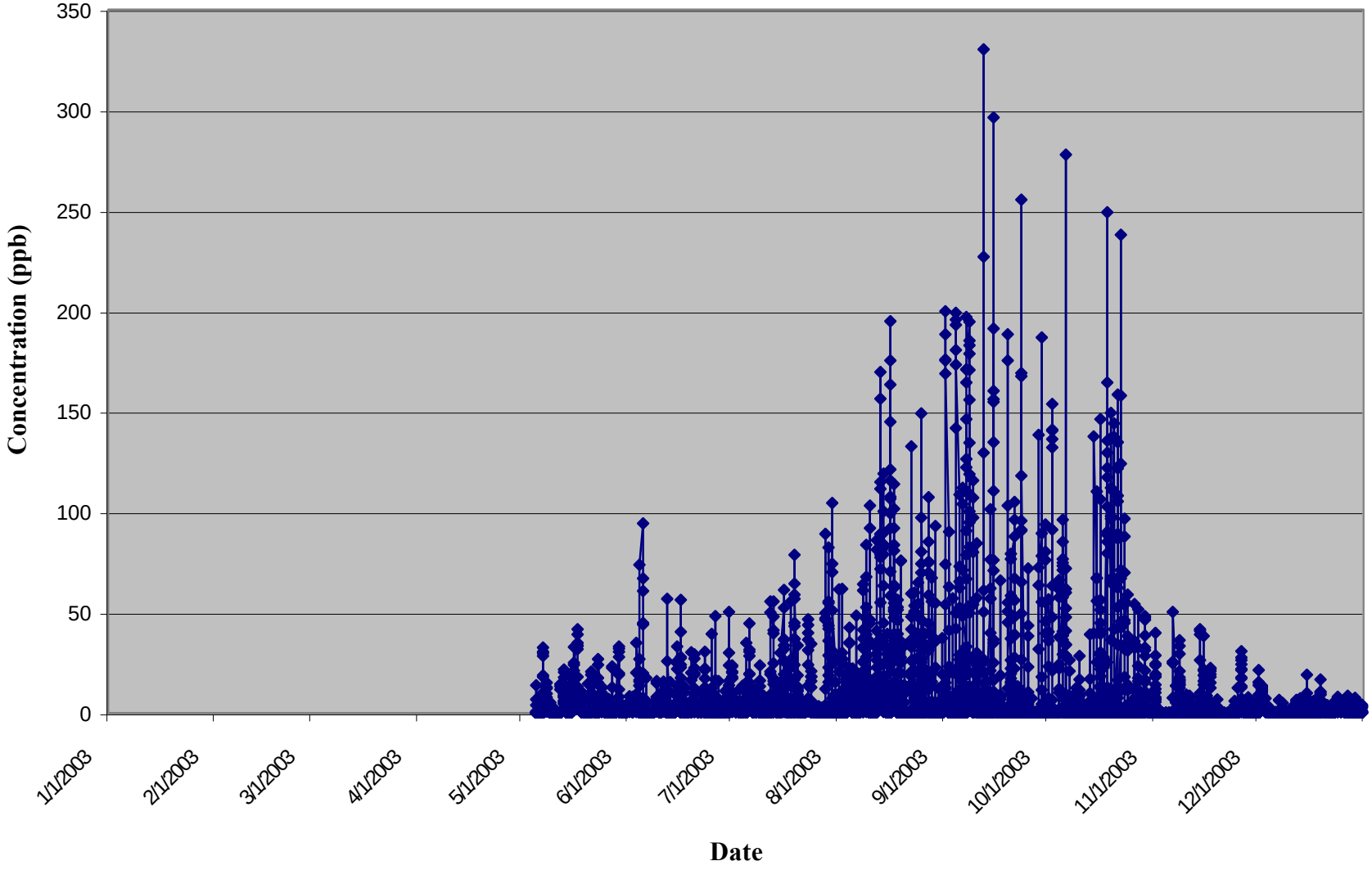


Malcom CAFO: Wind Speed vs Wind Direction

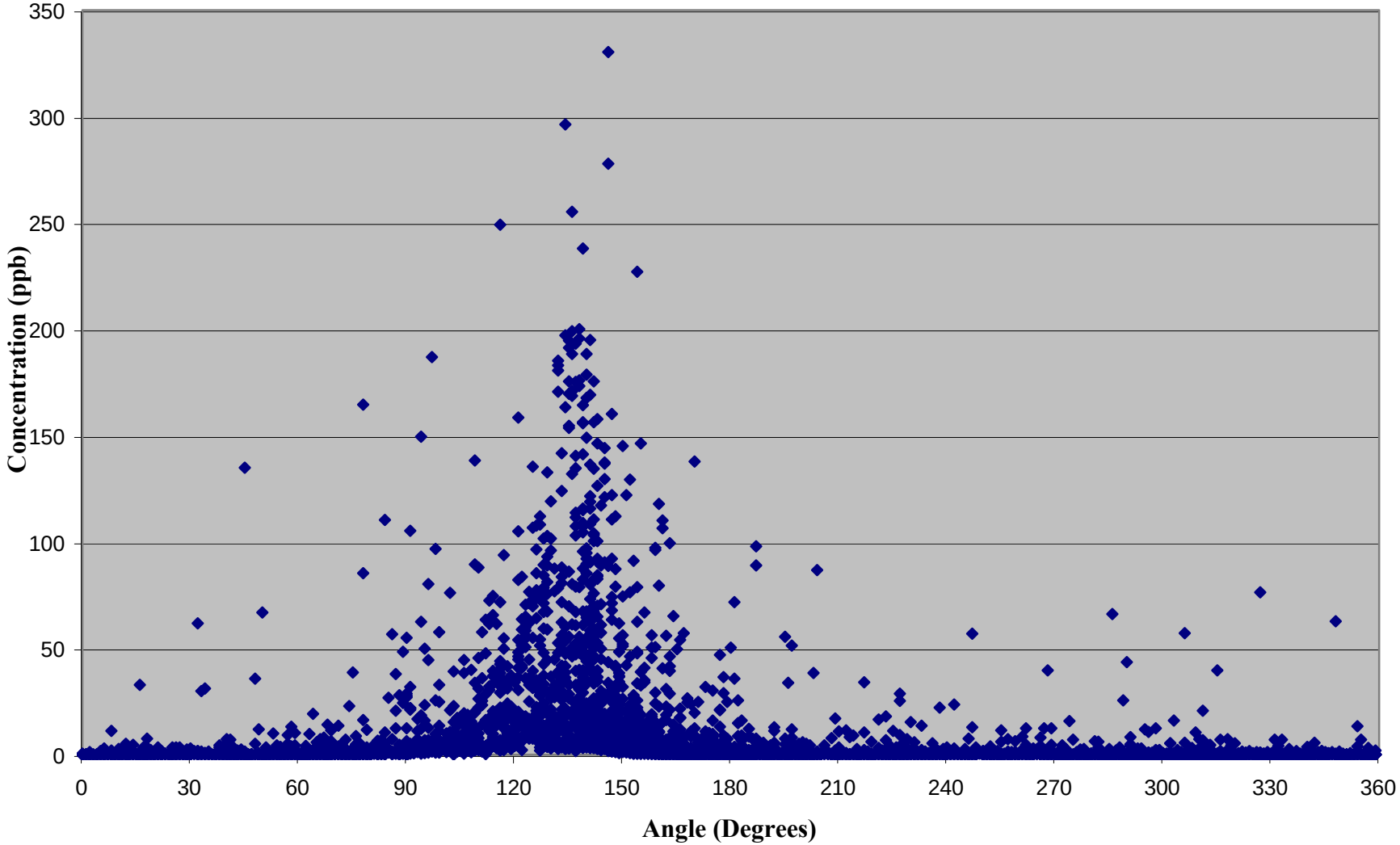



Sioux Center Monitoring Site
N
Monitor Site
Beef AFO
House
0.5 miles

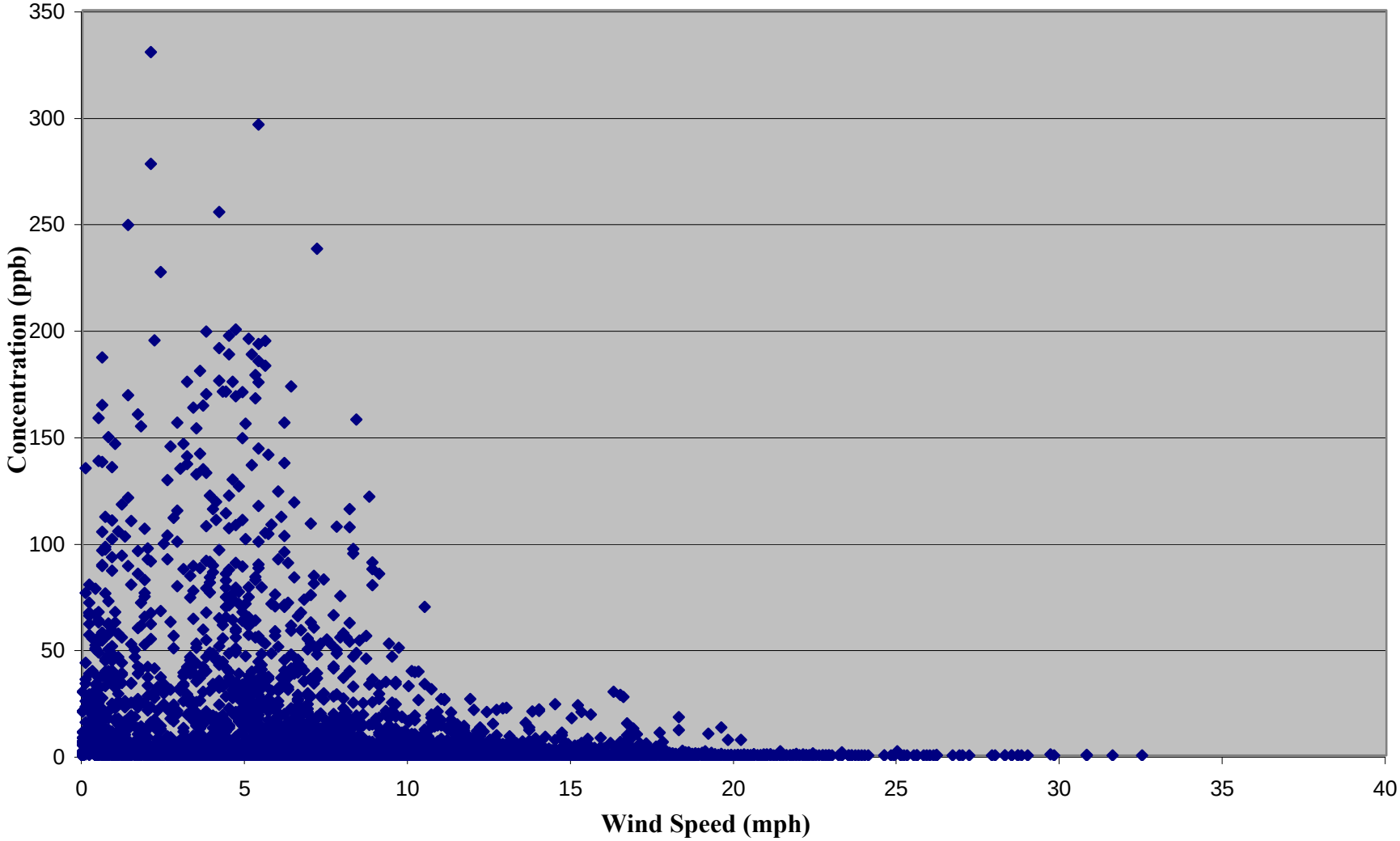
Sioux Center CAFO: Hydrogen Sulfide vs Time



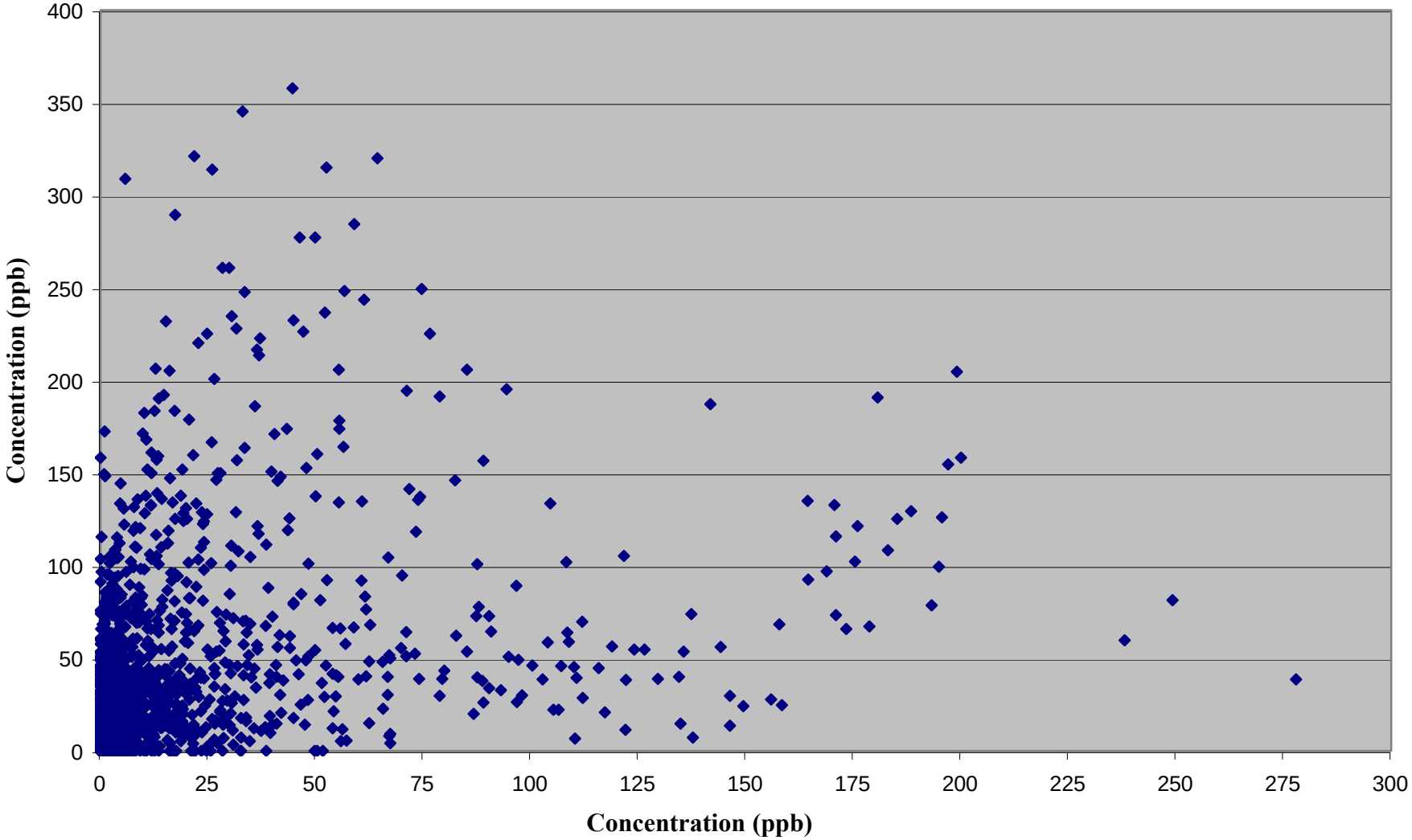
Sioux Center CAFO-Hydrogen Sulfide vs Wind Direction



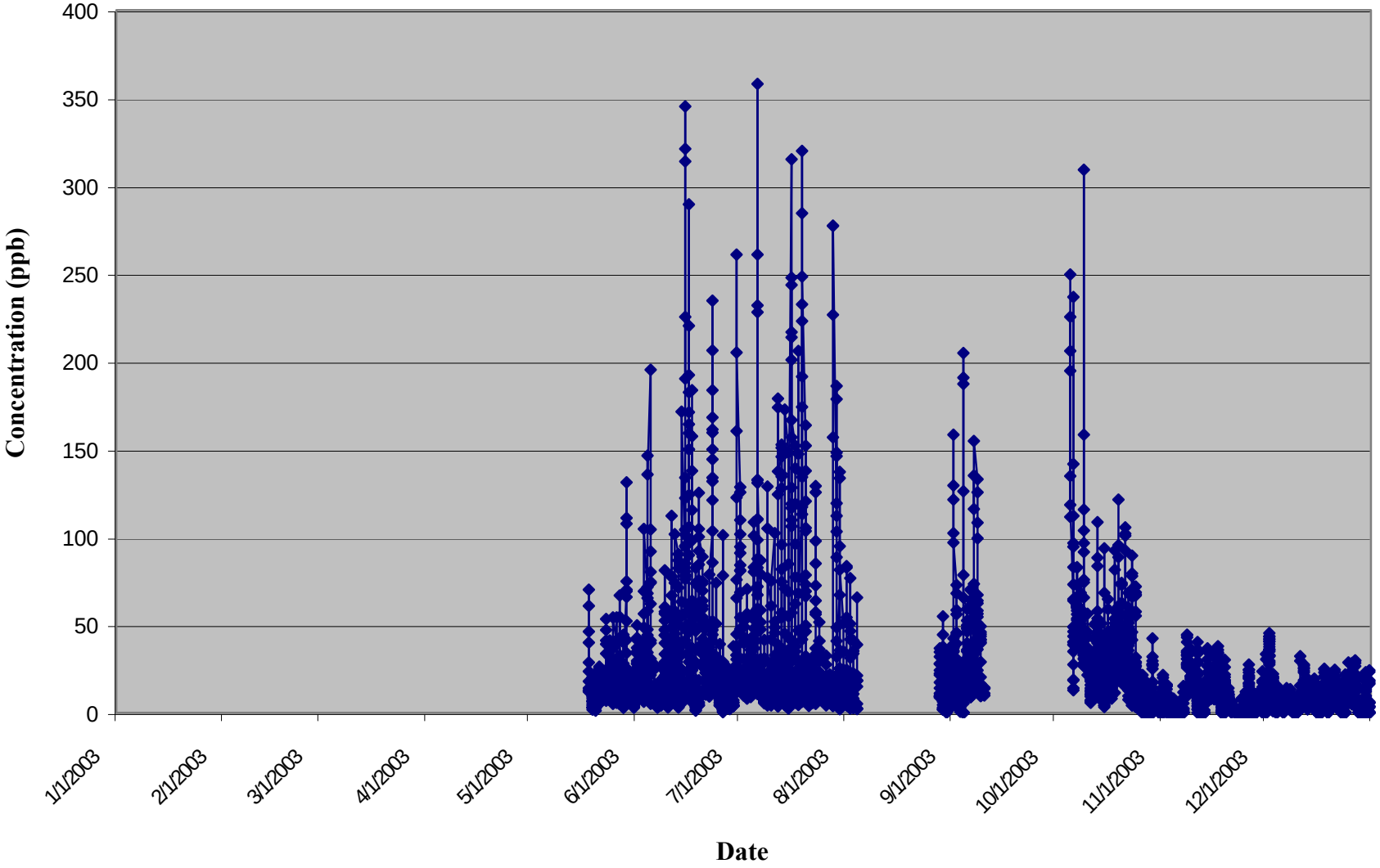
Sioux Center CAFO: Hydrogen Sulfide vs Wind Speed



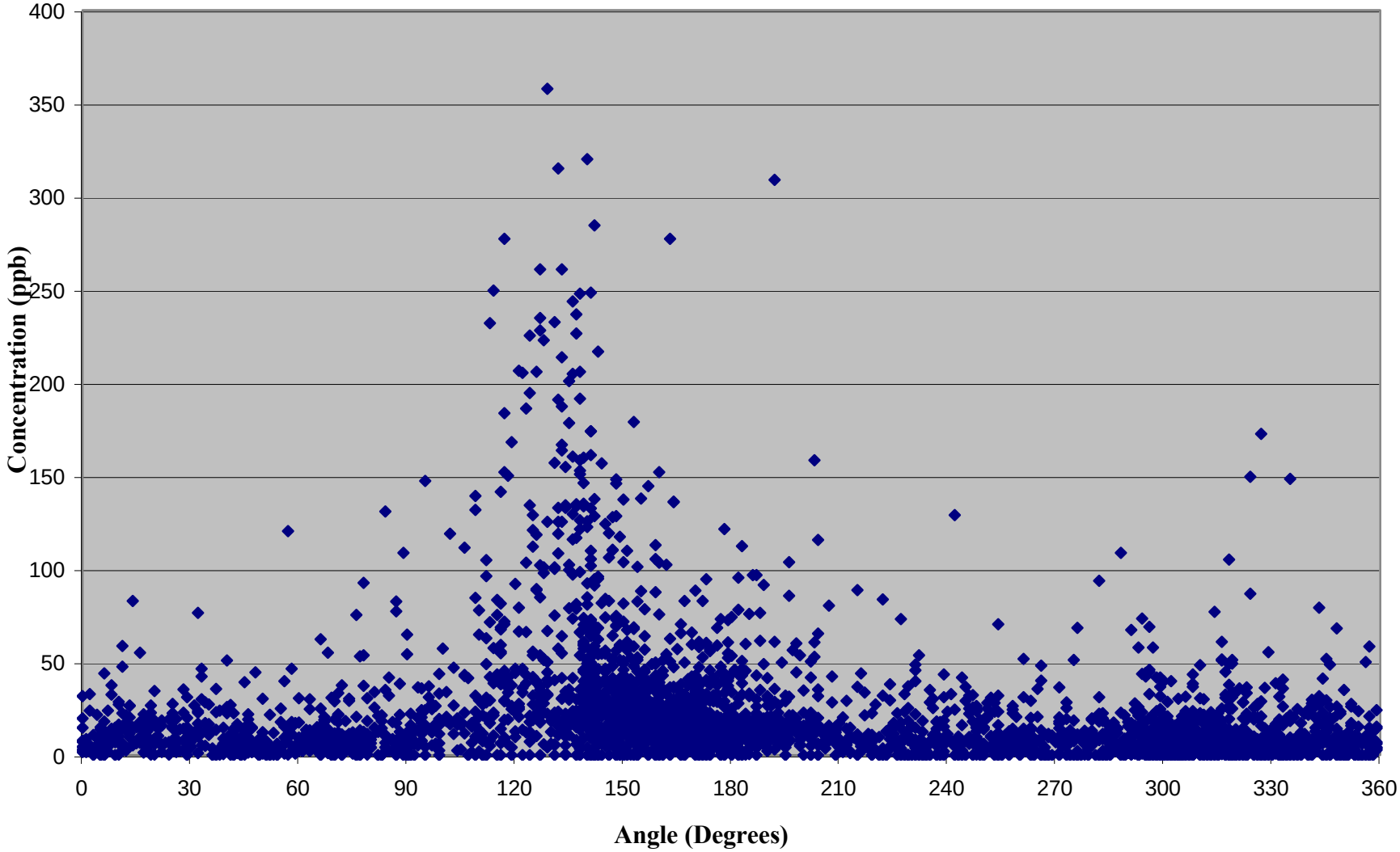
Sioux Center CAFO: Ammonia vs Hydrogen Sulfide

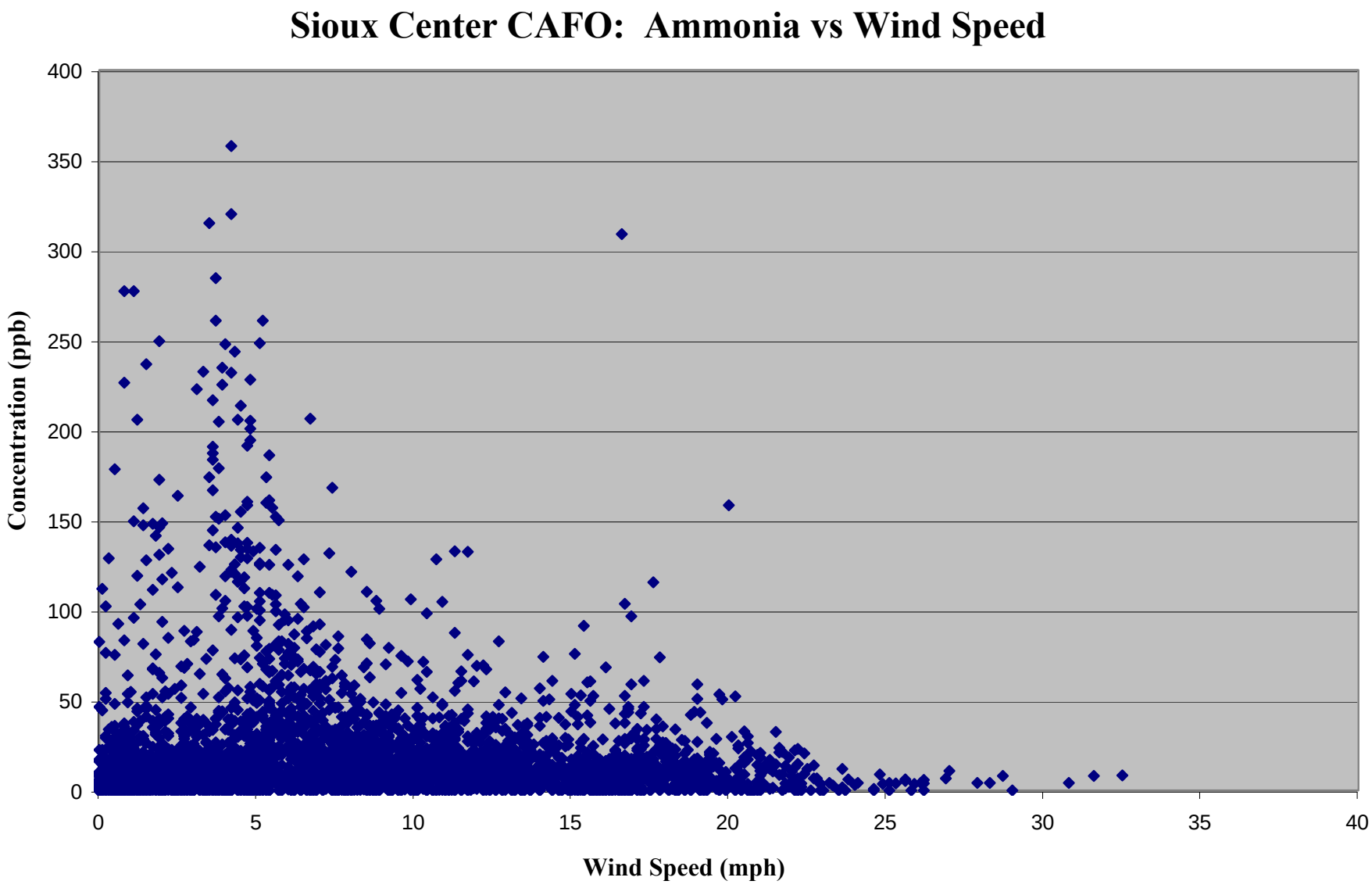


Sioux Center CAFO: Ammonia vs Time

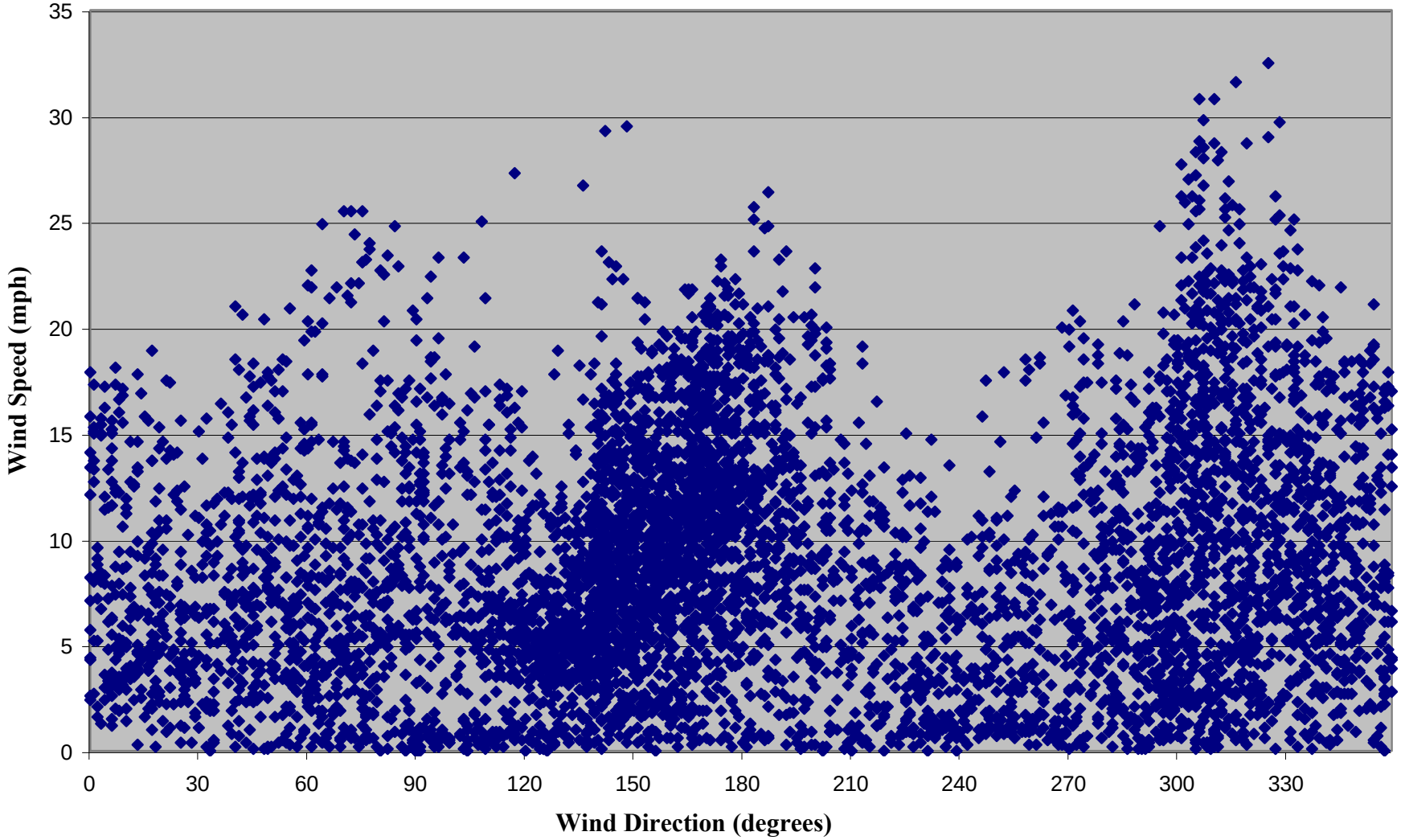


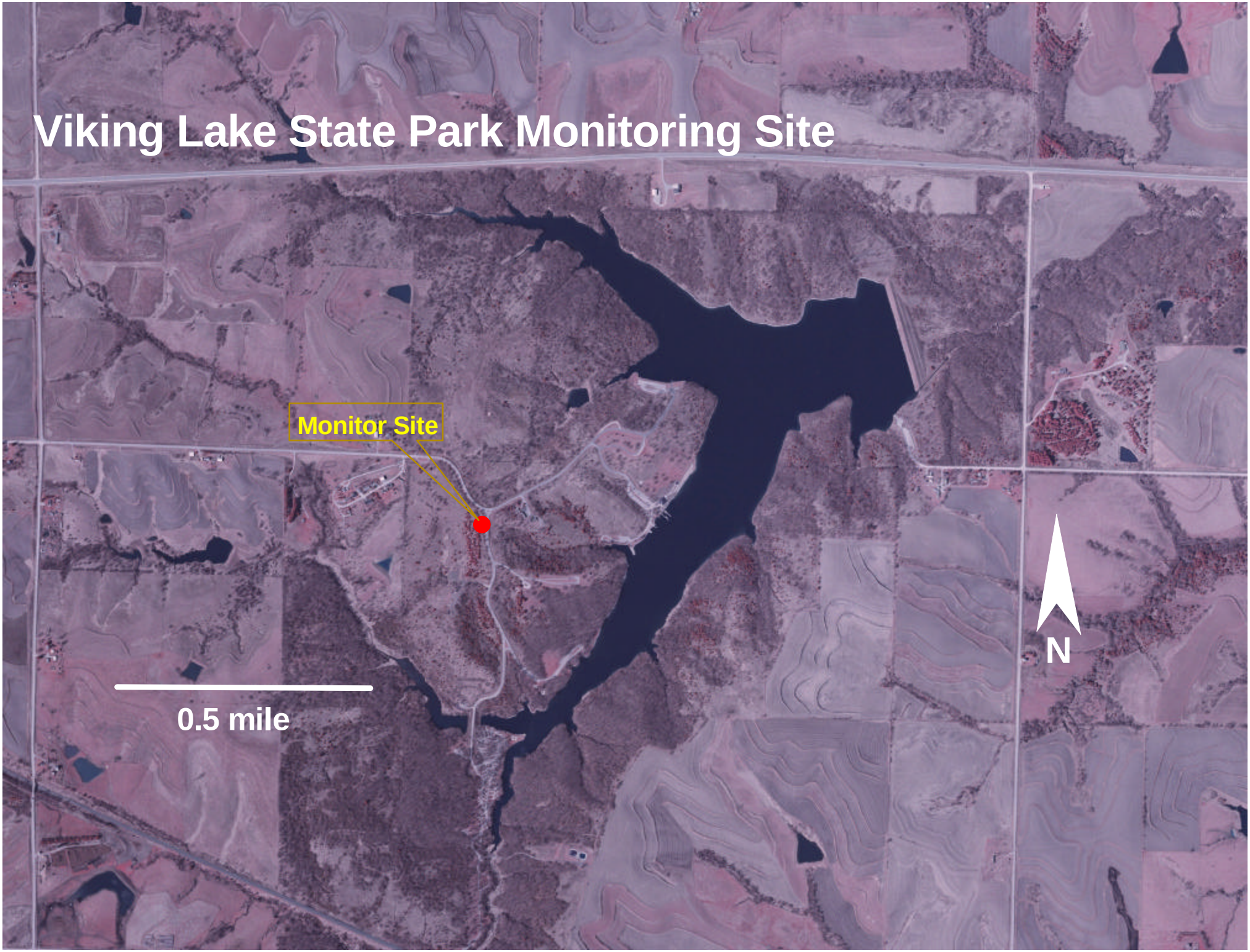
Sioux Center CAFO: Ammonia vs Wind Direction

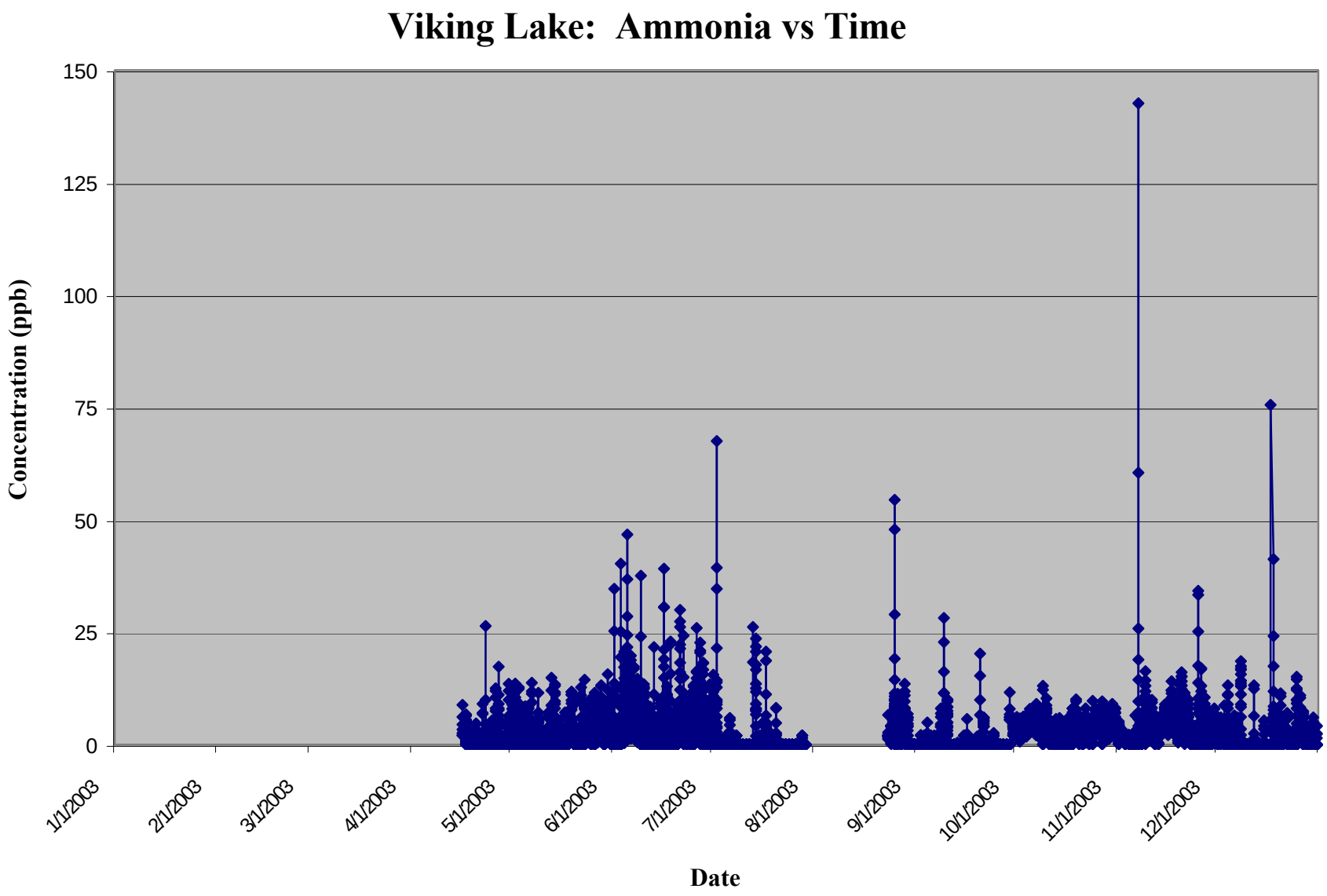



Sioux Center CAFO: Ammonia vs Wind Speed
Concentration (ppb)
400
350
300
250
200
150
100
50
0
0
5
10
15
20
25
30
35
40
Wind Speed (mph)

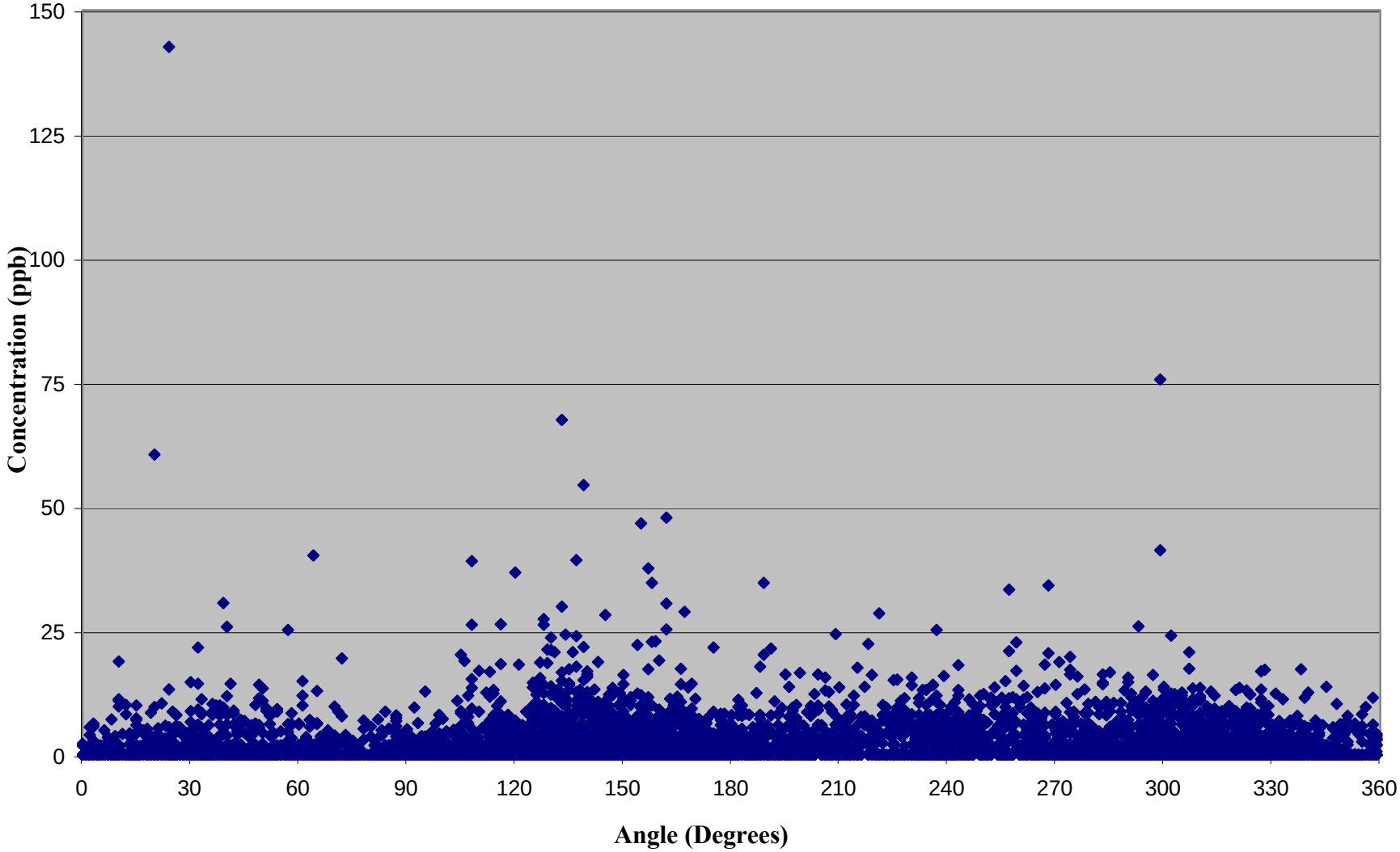
Sioux Center CAFO: Wind Speed vs Wind Direction

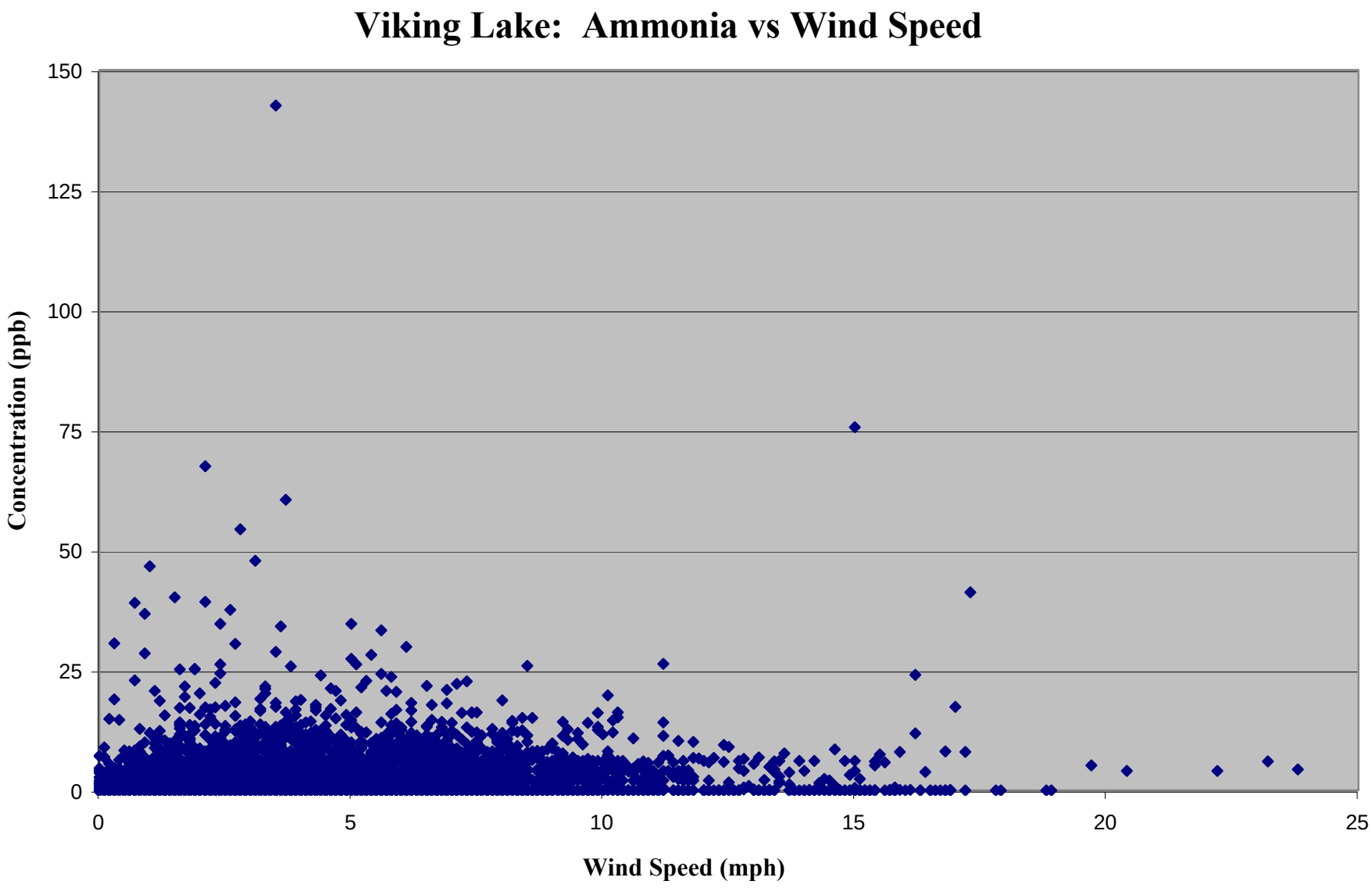



Viking Lake State Park Monitoring Site
Monitor Site
0.5 mile
N

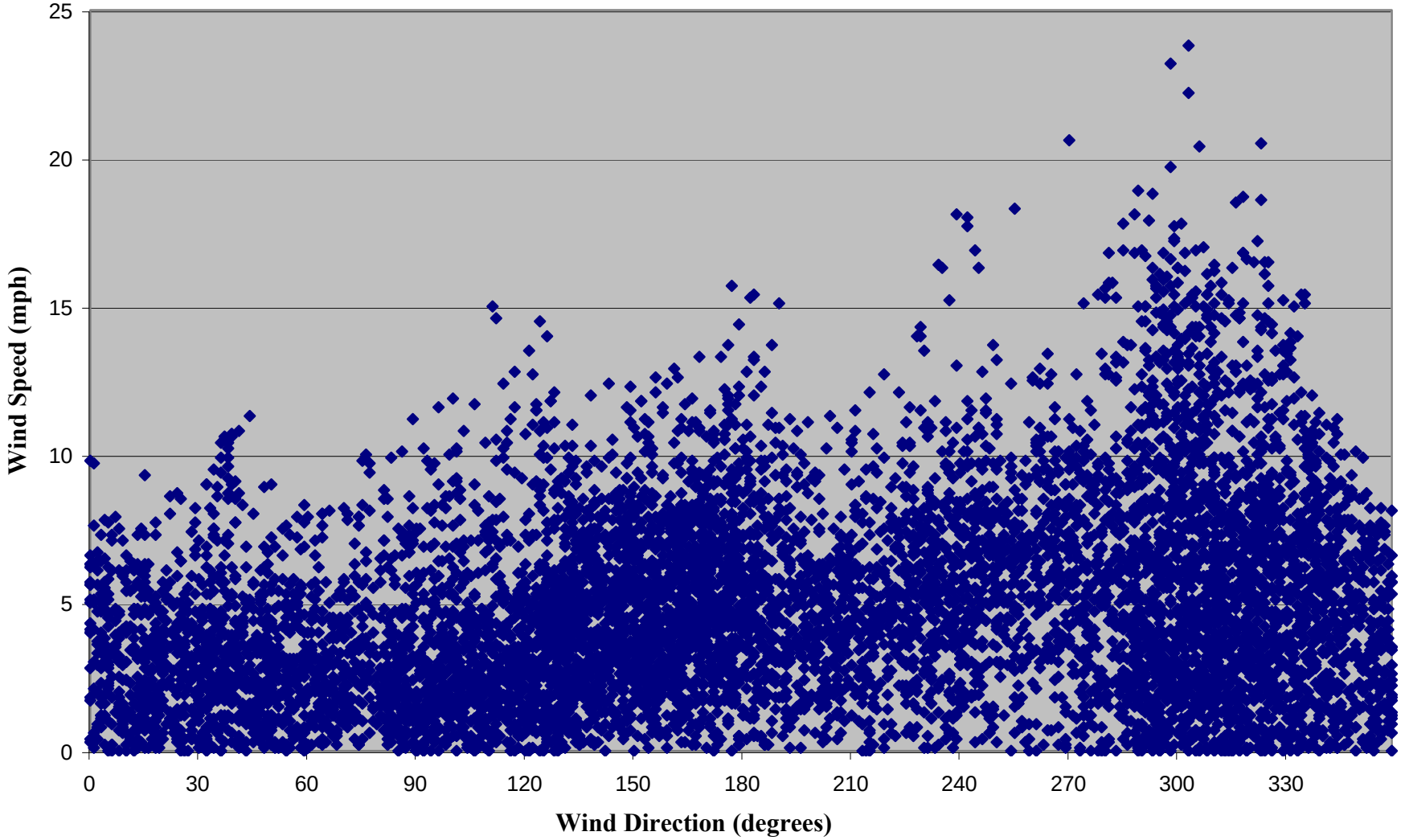

Viking Lake: Ammonia vs Time
Concentration (ppb)
150
125
100
75
50
25
0
1/1/2003
2/1/2003
3/1/2003
4/1/2003
5/1/2003
6/1/2003
7/1/2003
8/1/2003
9/1/2003
10/1/2003
11/1/2003
12/1/2003
Date

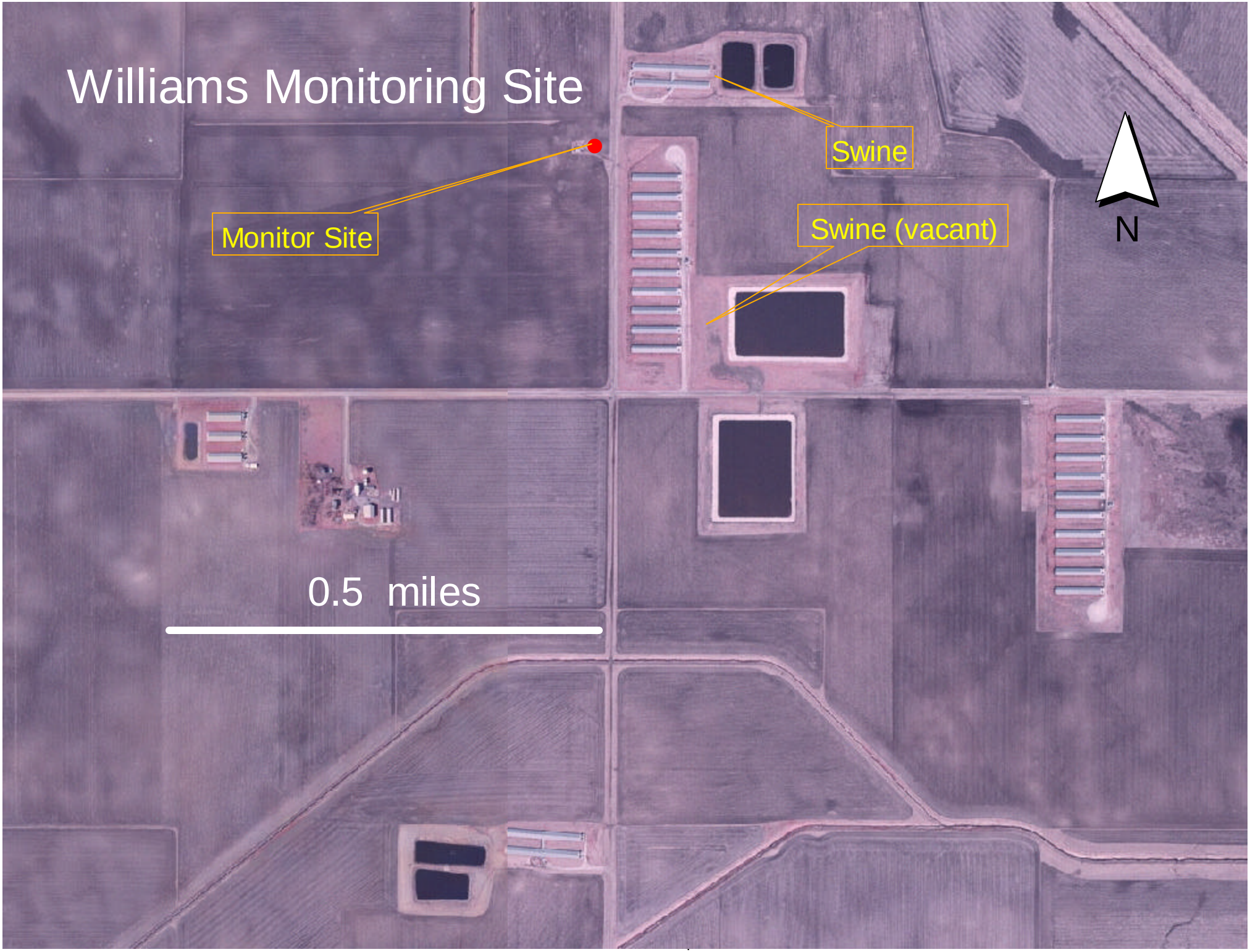
Viking Lake: Ammonia vs Wind Direction



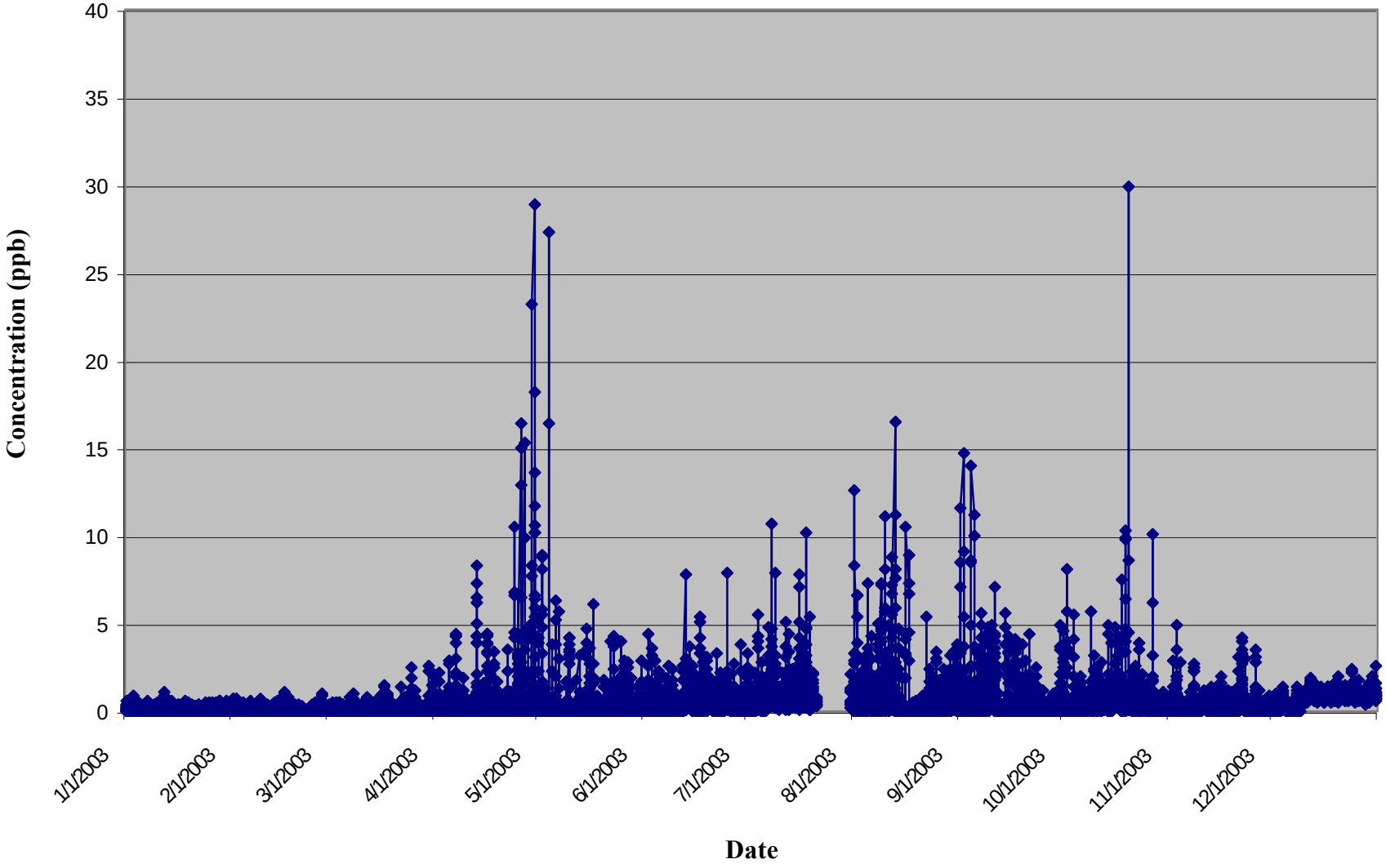

Viking Lake: Ammonia vs Wind Speed
Concentration (ppb)
150
125
100
75
50
25
0
0
5
10
15
20
25
Wind Speed (mph)

Viking Lake: Wind Speed vs Wind Direction

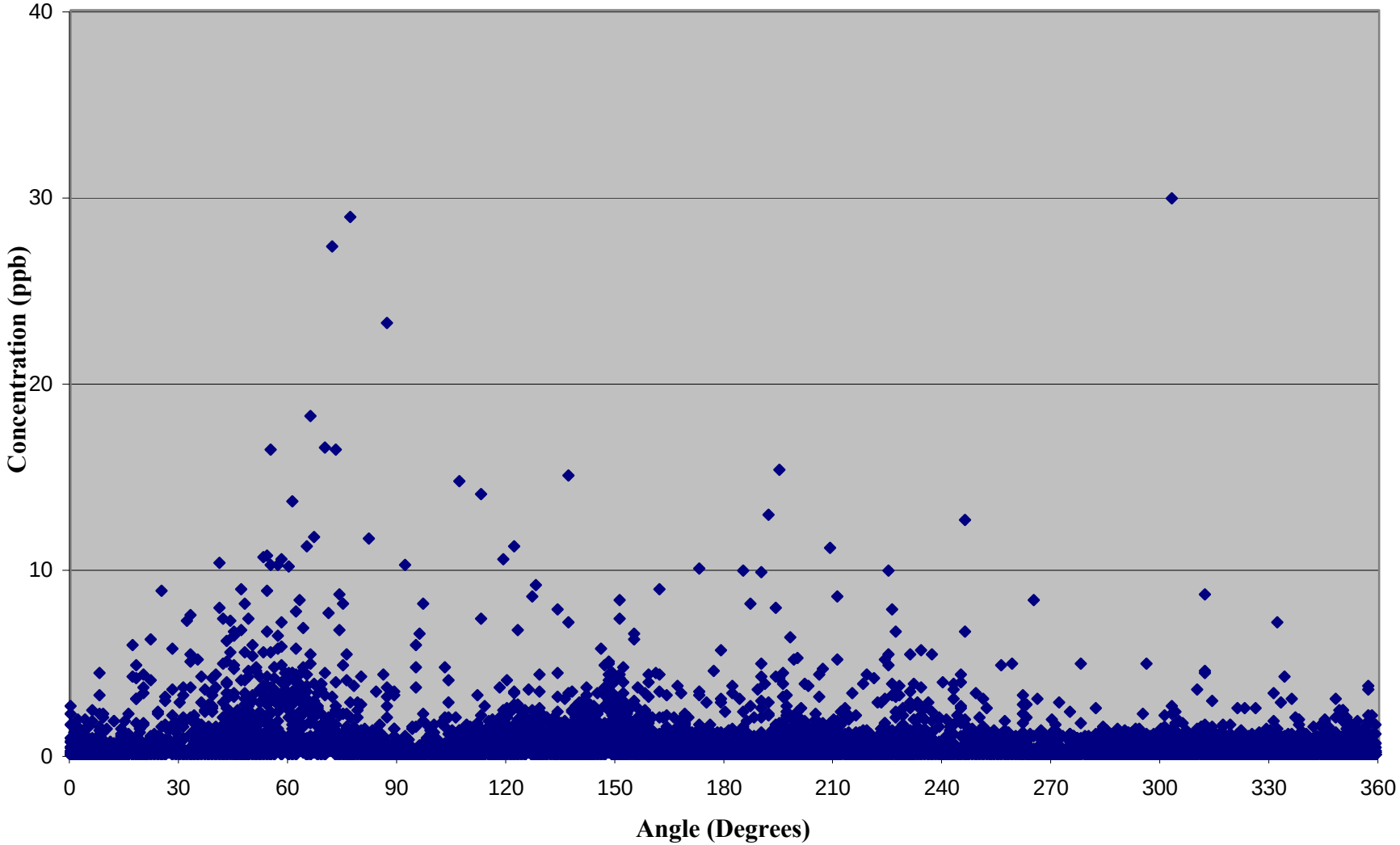



Williams Monitoring Site
Swine
Monitor Site
Swine (vacant)
N
0.5 miles

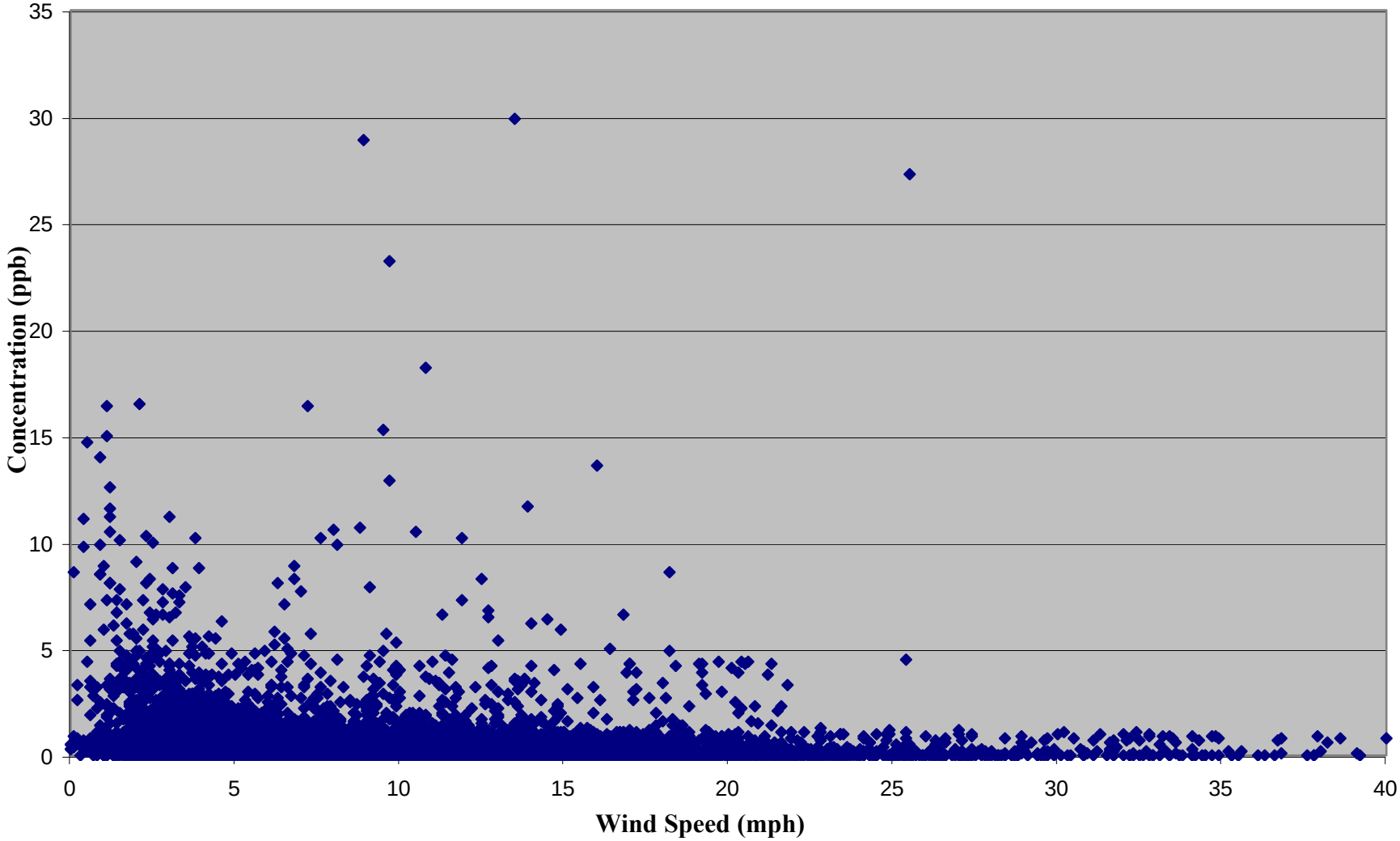
Williams CAFO: Hydrogen Sulfide vs Time



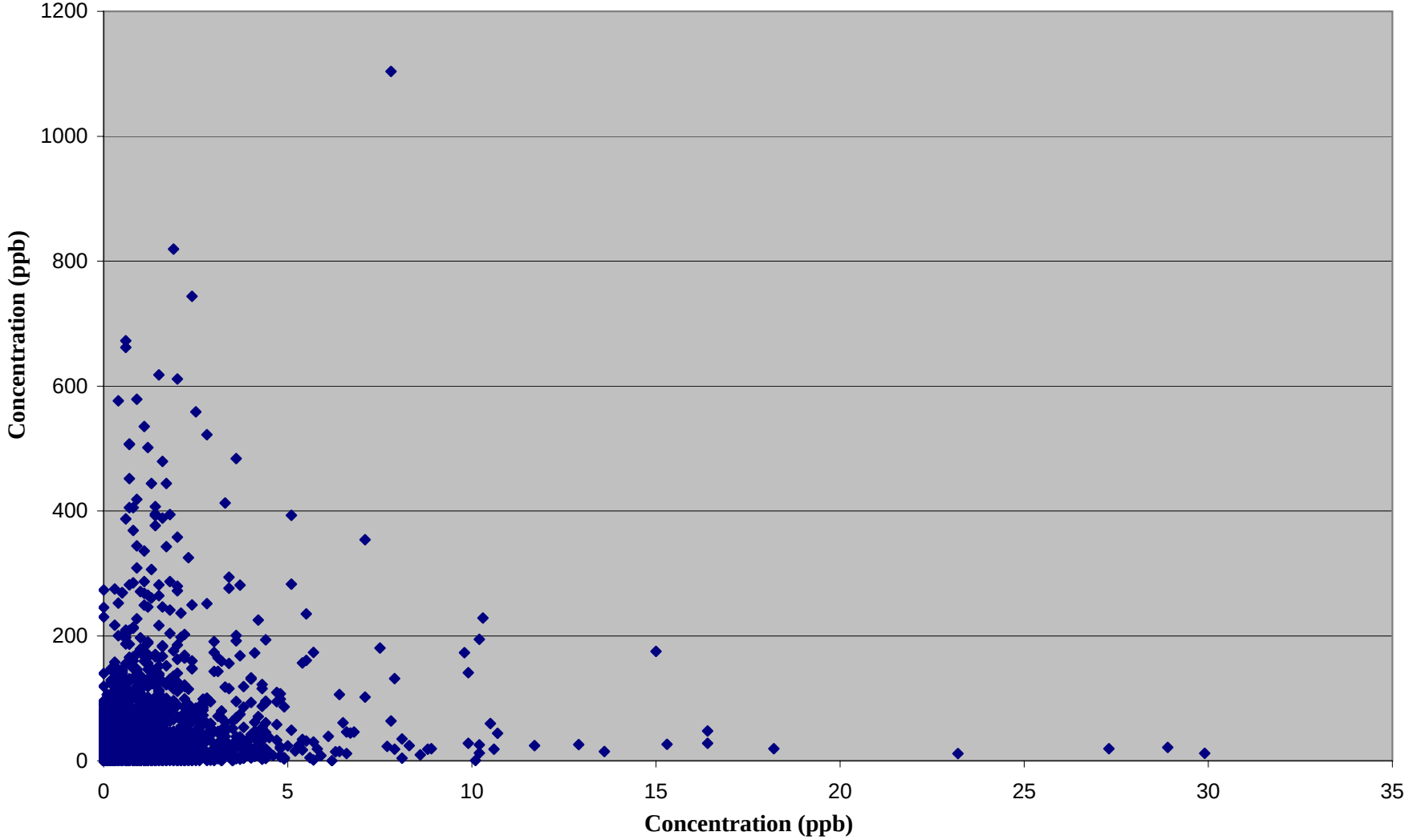
Williams CAFO-Hydrogen Sulfide vs Wind Direction



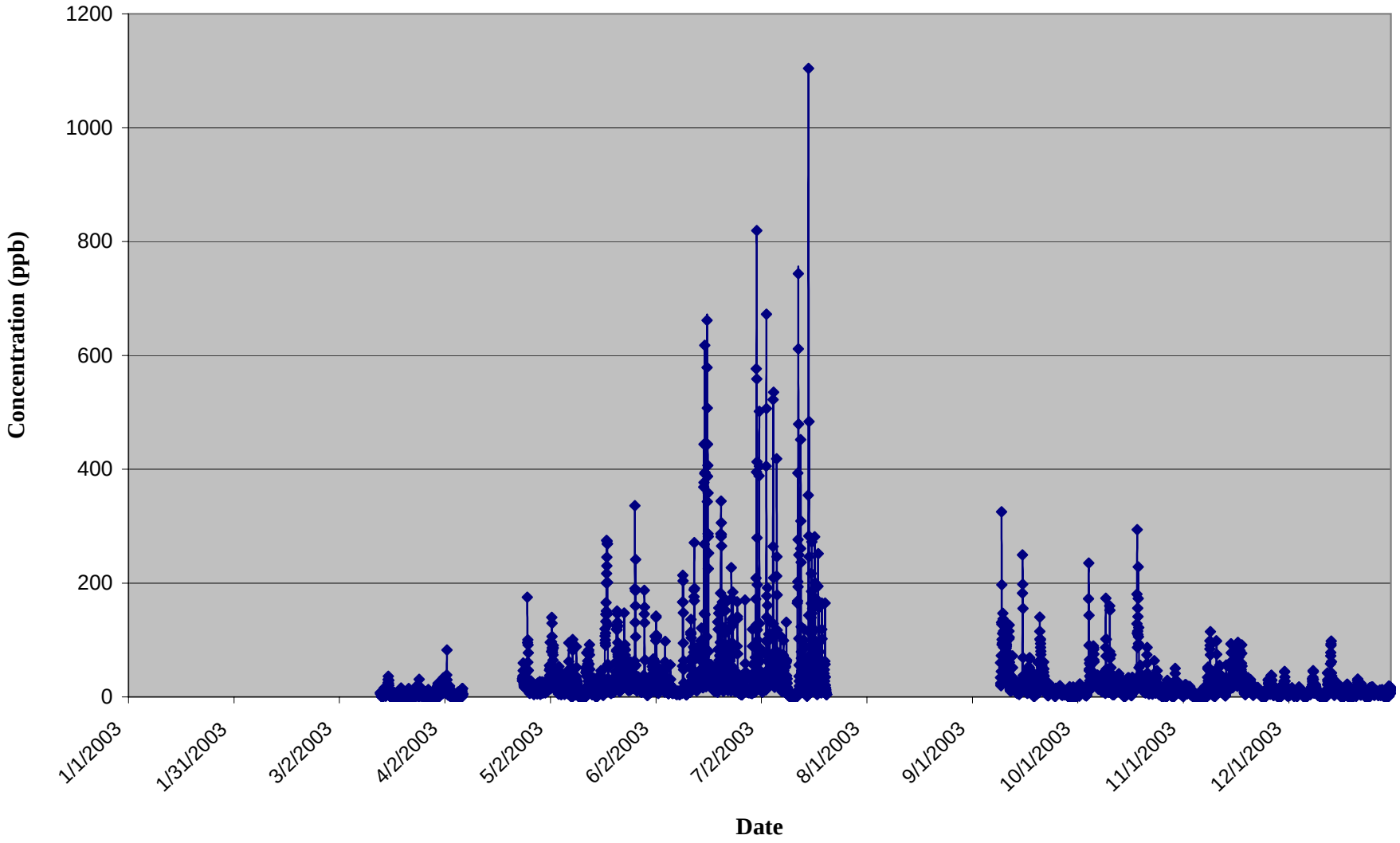
Williams CAFO: Hydrogen Sulfide vs Wind Speed



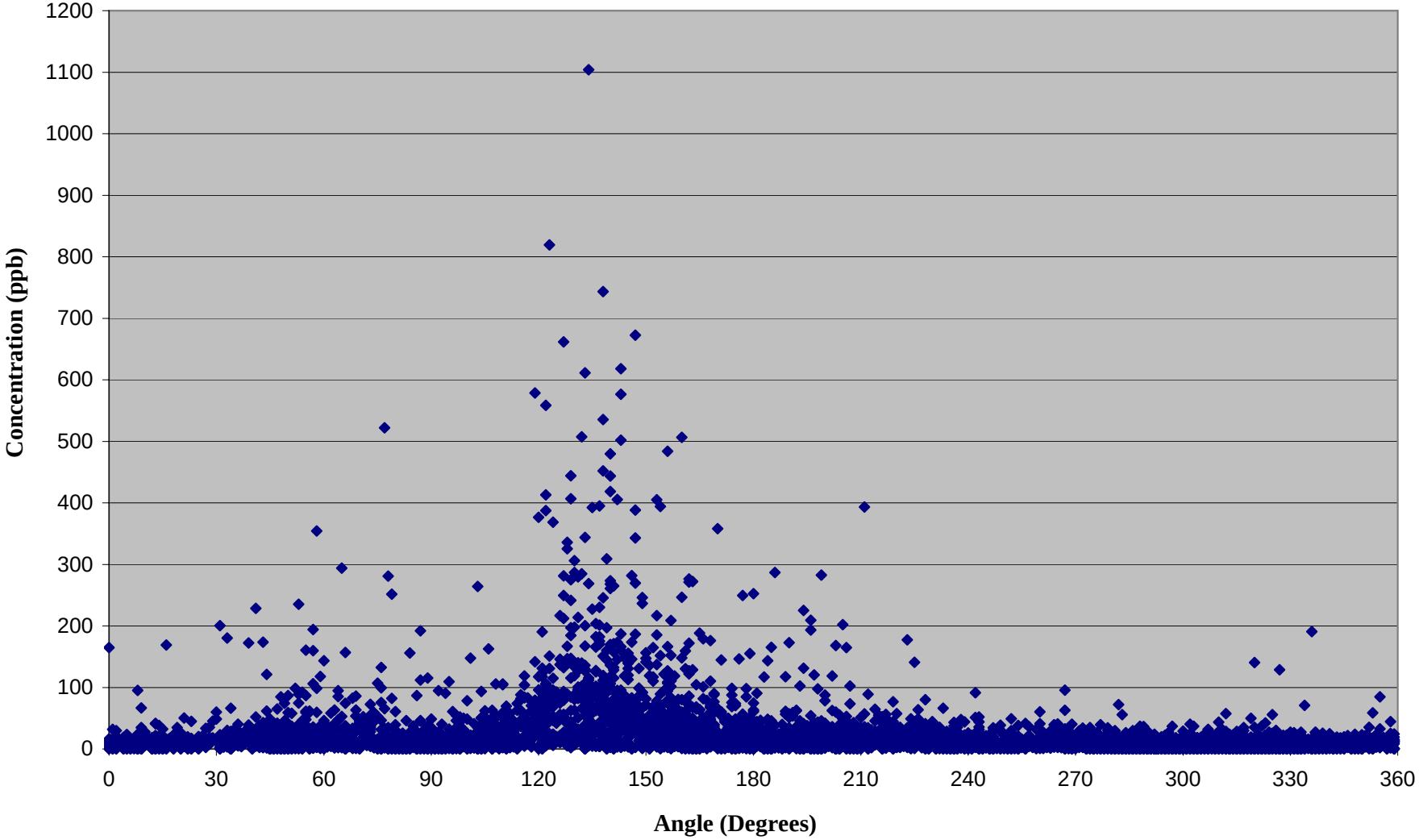
Williams CAFO: Ammonia vs Hydrogen Sulfide

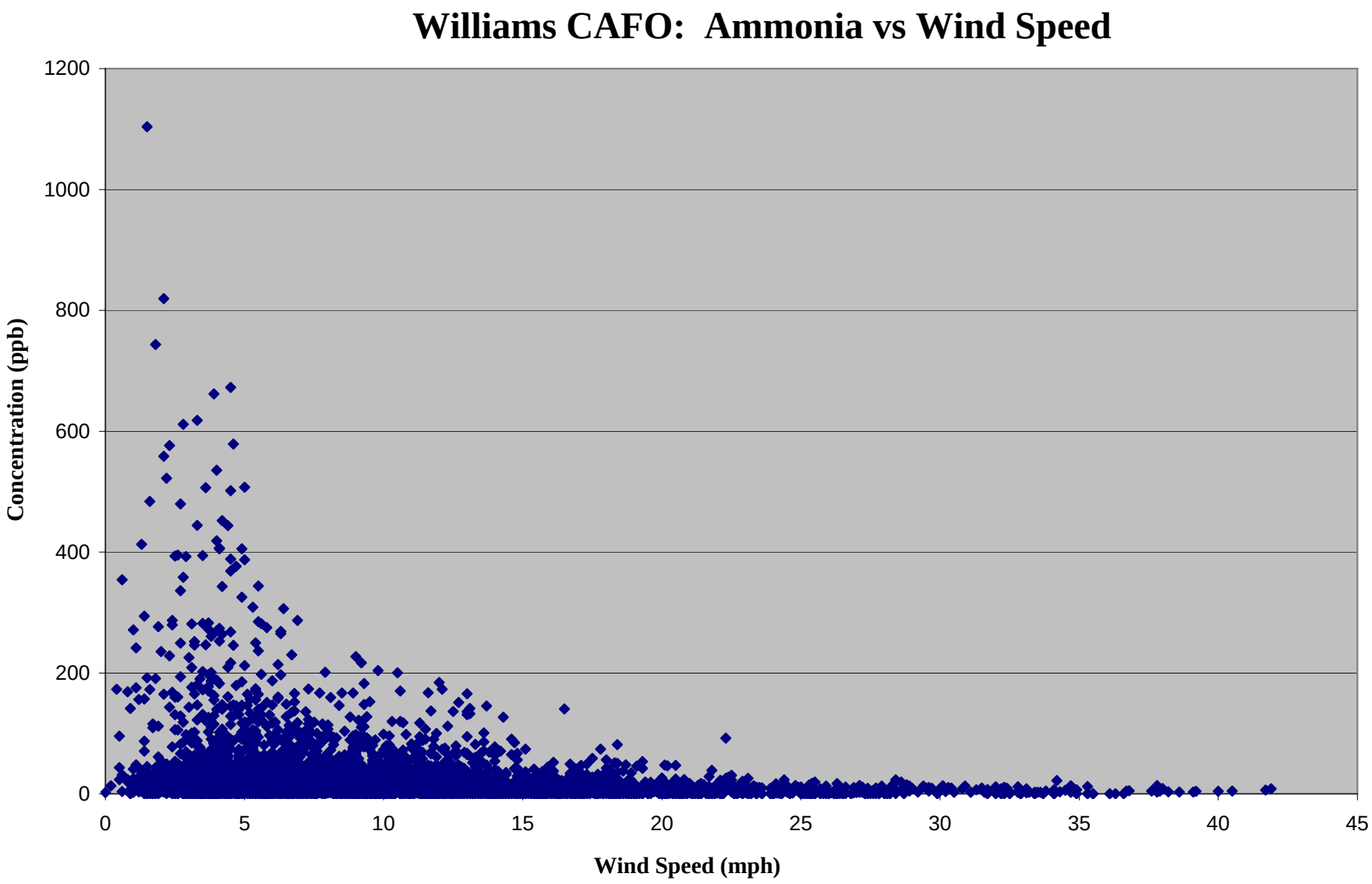


Williams CAFO: Ammonia vs Time

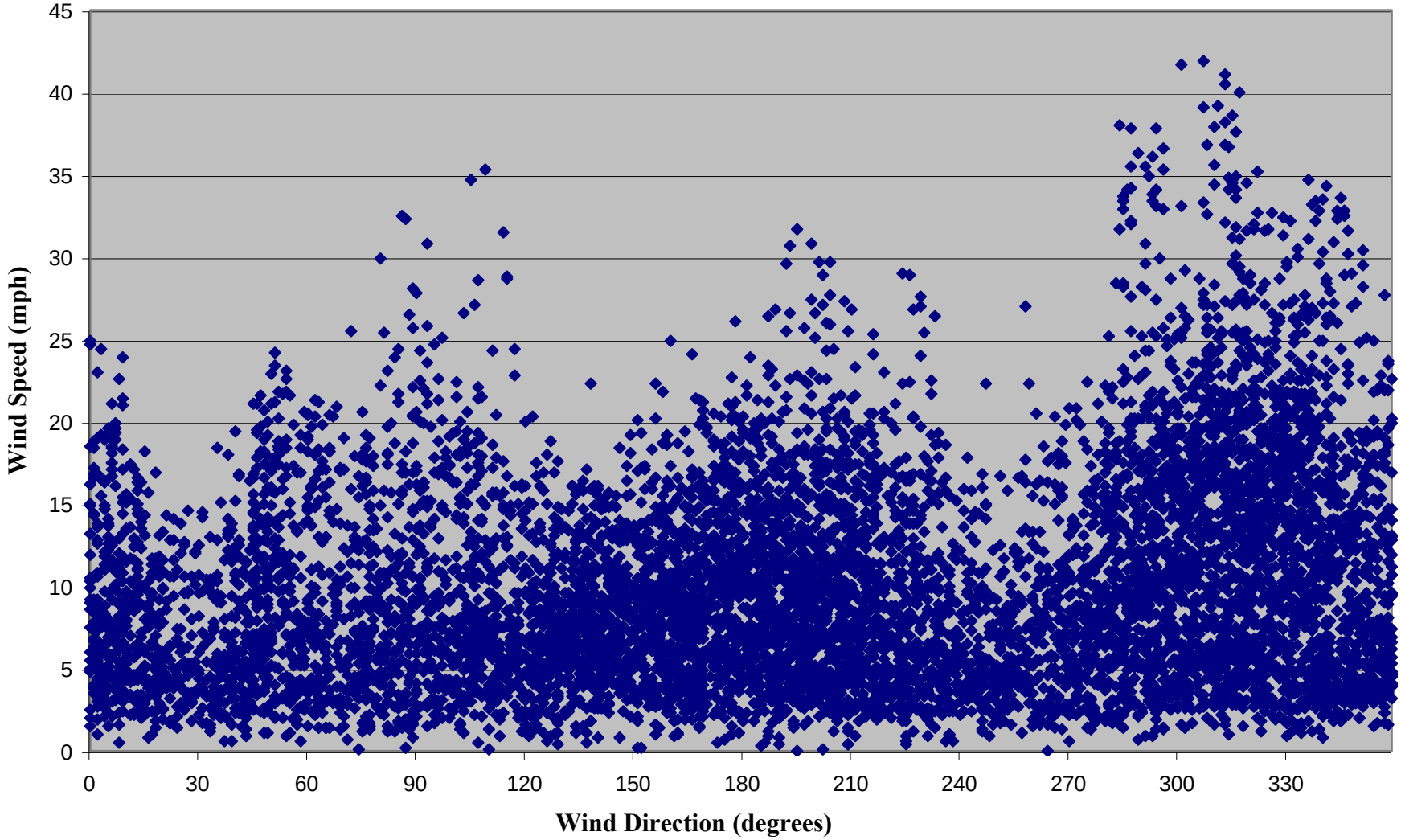


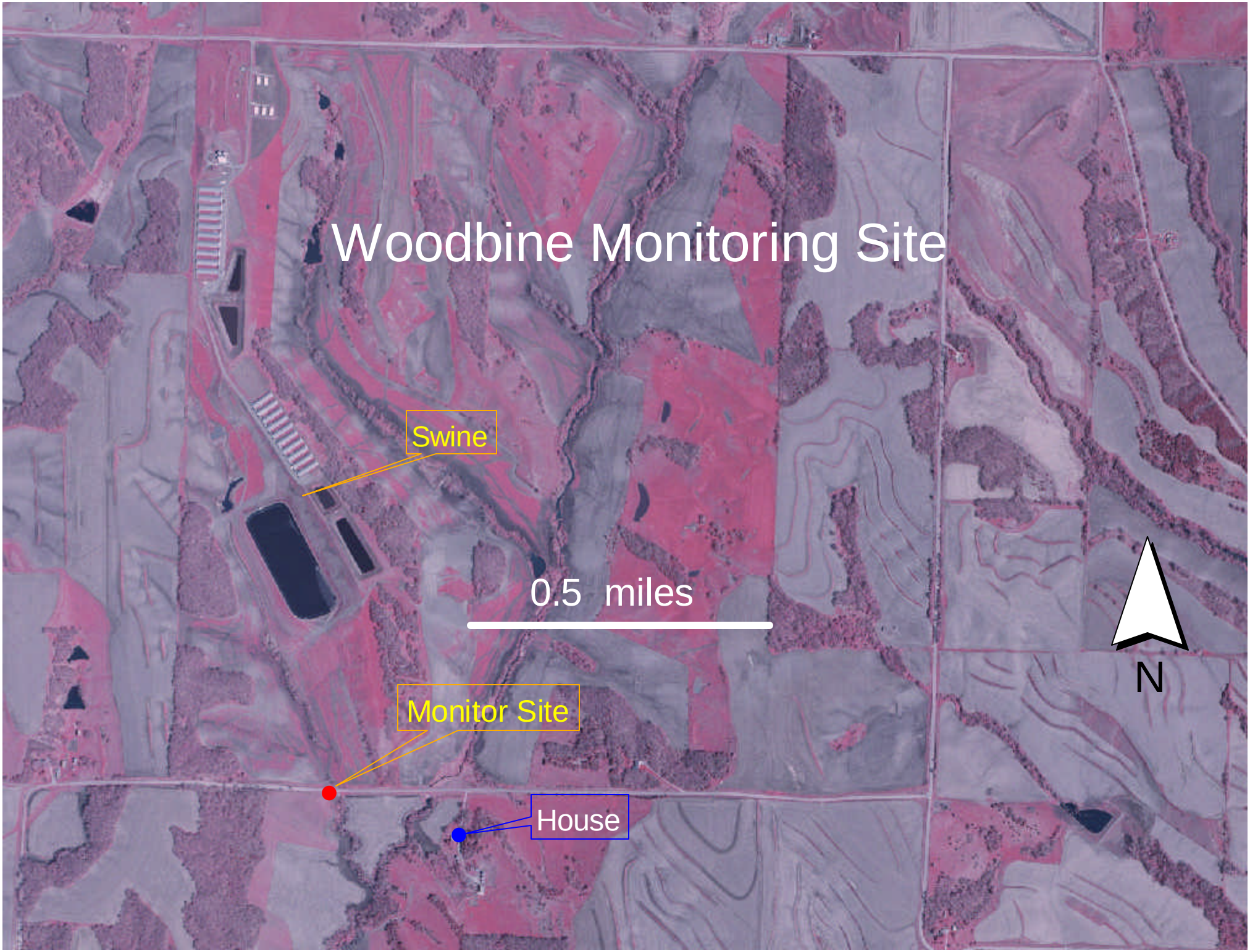
Williams CAFO: Ammonia vs Wind Direction

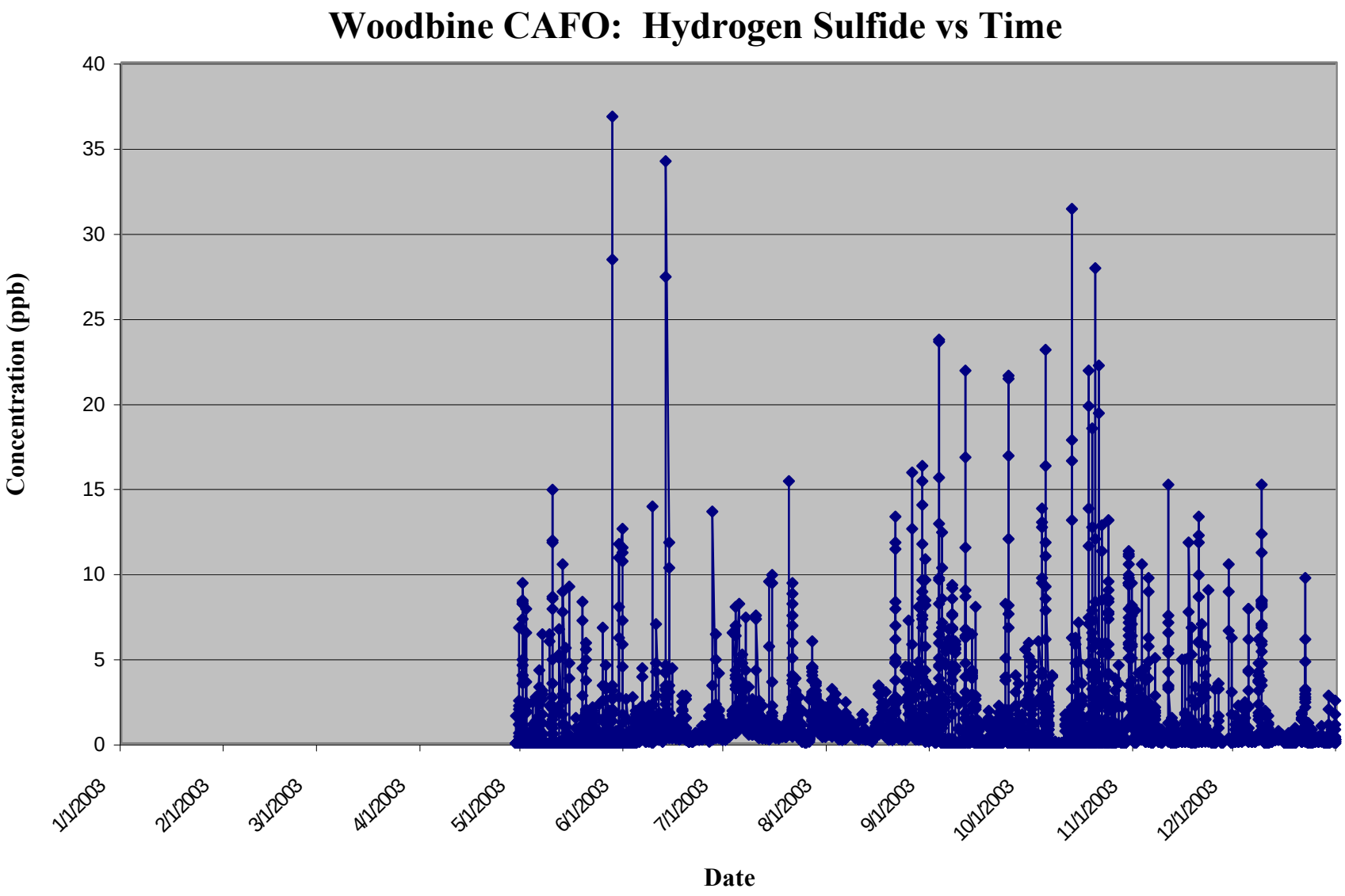



Williams CAFO: Ammonia vs Wind Speed
Concentration (ppb)
1200
1000
800
600
400
200
0
0
5
10
15
20
25
30
35
40
45
Wind Speed (mph)

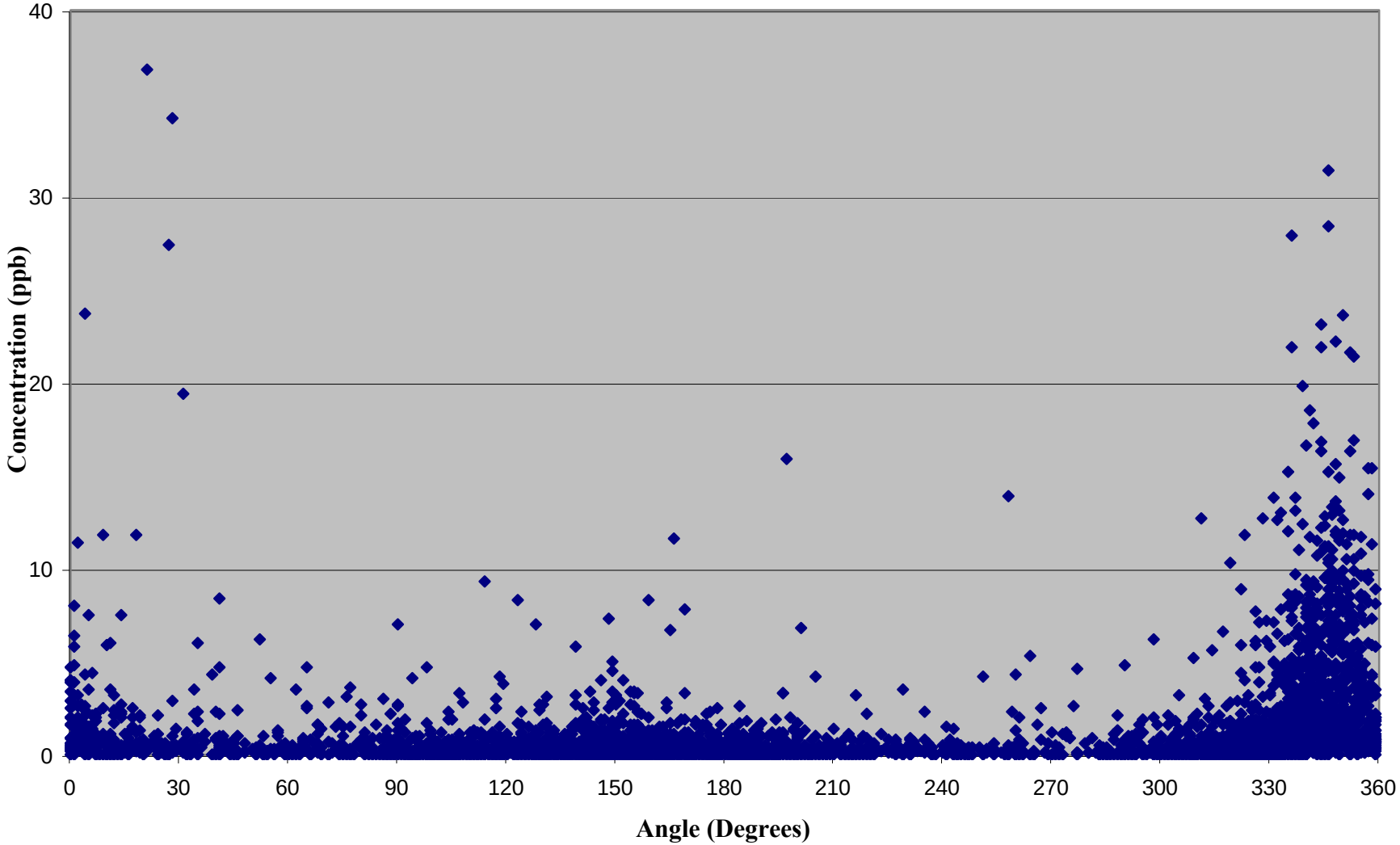
Williams CAFO: Wind Speed vs Wind Direction



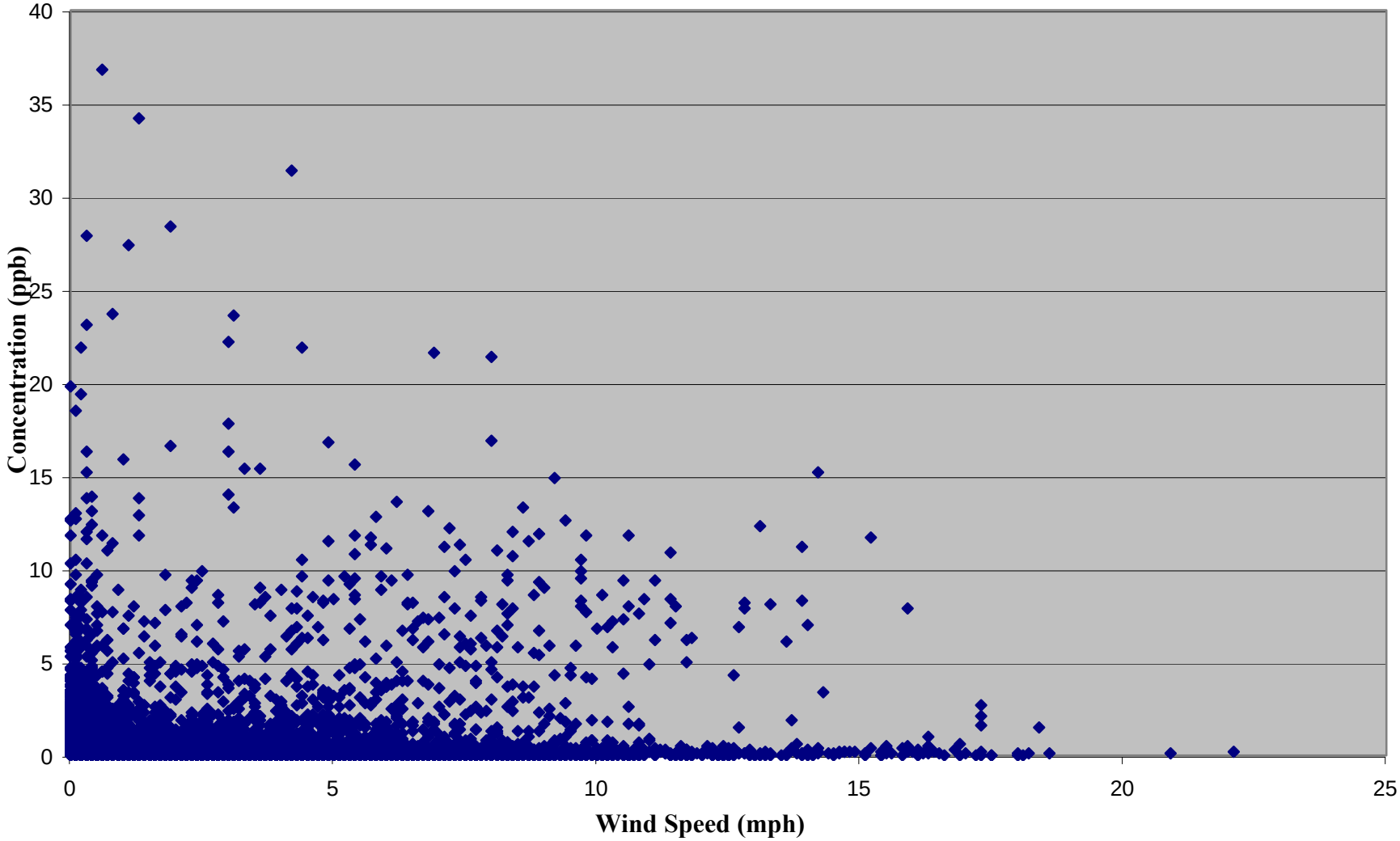

Woodbine Monitoring Site
Swine
0.5 miles
N
Monitor Site
House


Woodbine CAFO: Hydrogen Sulfide vs Time
Concentration (ppb)
40
35
30
25
20
15
10
5
0
1/1/2003
2/1/2003
3/1/2003
4/1/2003
5/1/2003
6/1/2003
7/1/2003
8/1/2003
9/1/2003
10/1/2003
11/1/2003
12/1/2003
Date

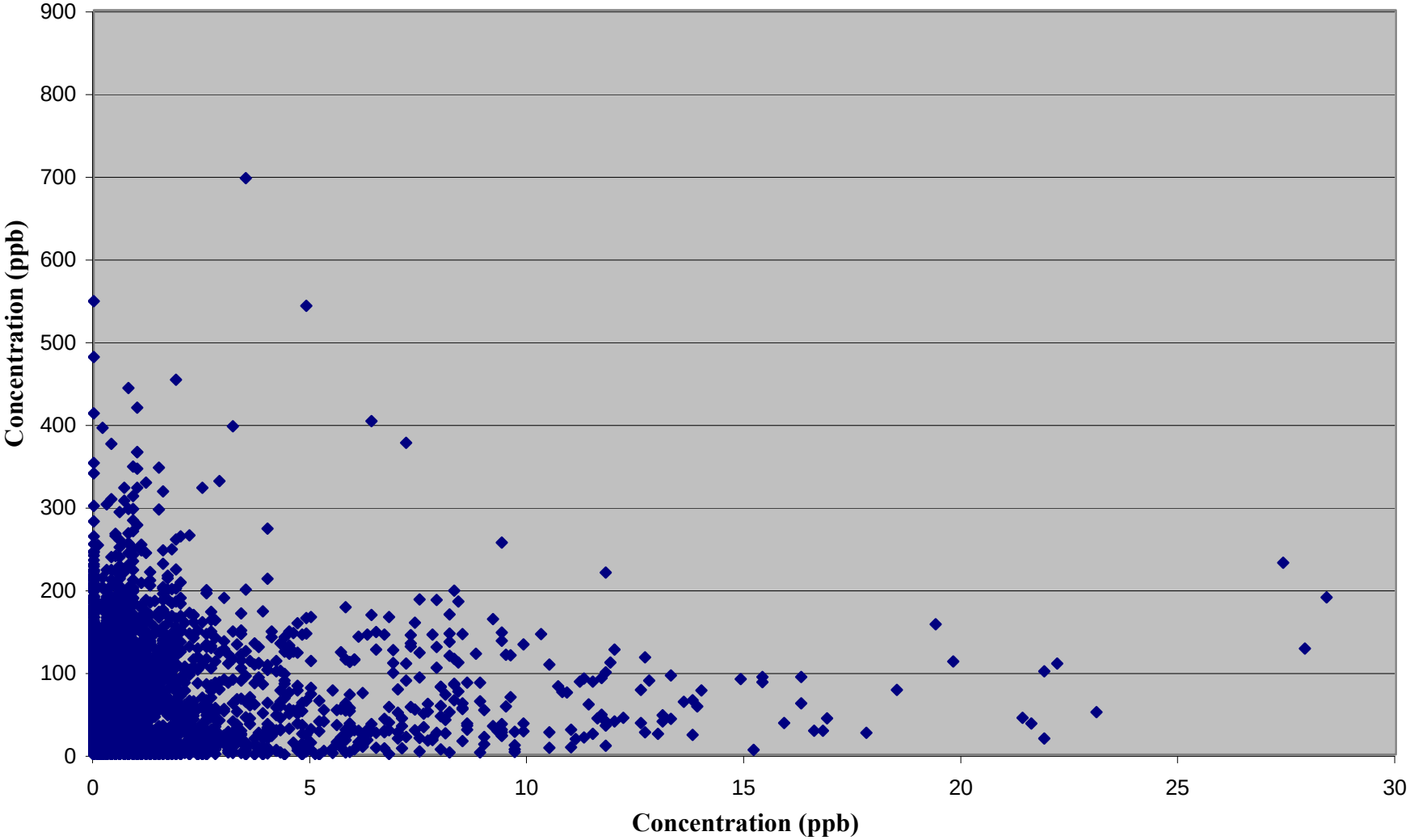
Woodbine CAFO-Hydrogen Sulfide vs Wind Direction

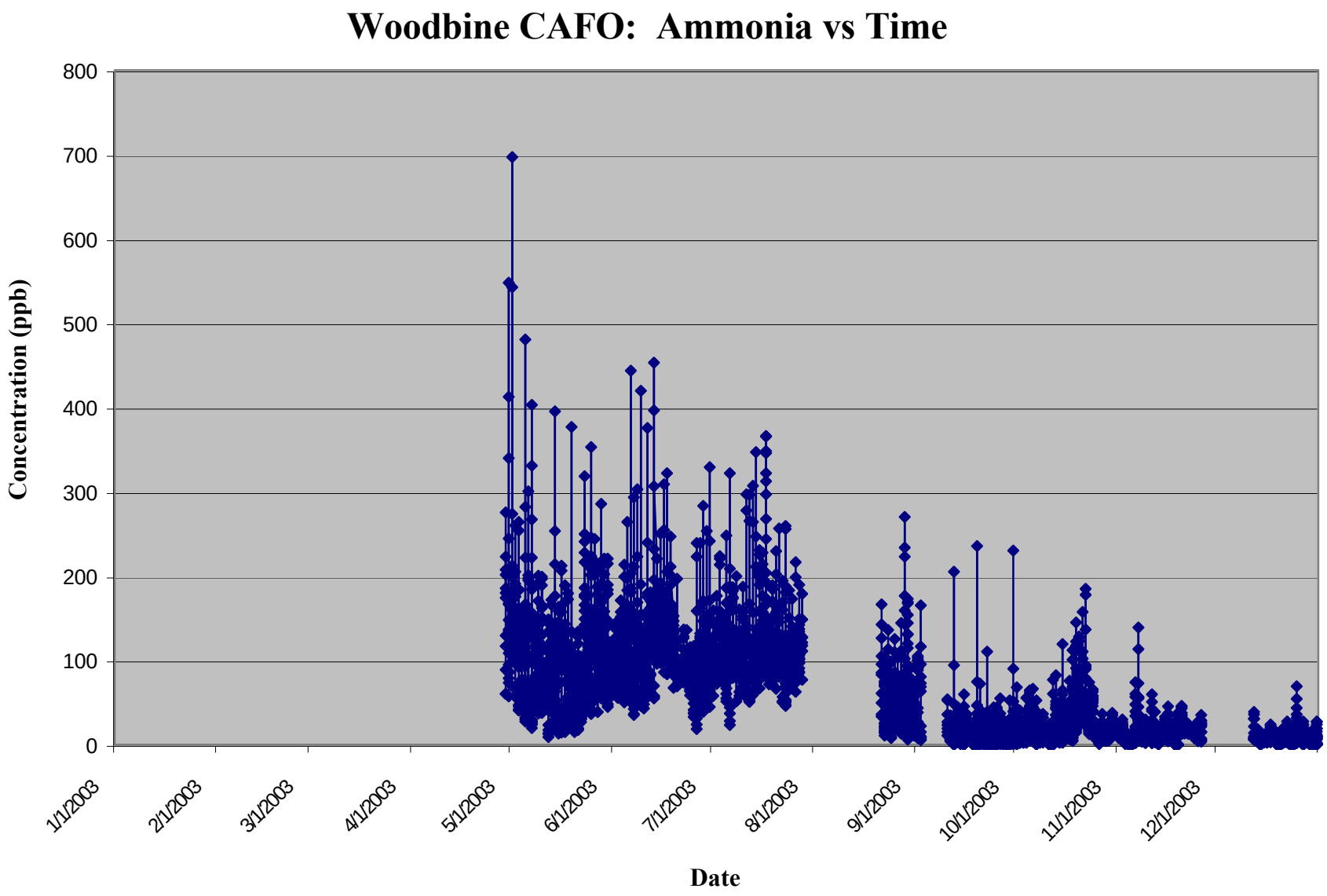


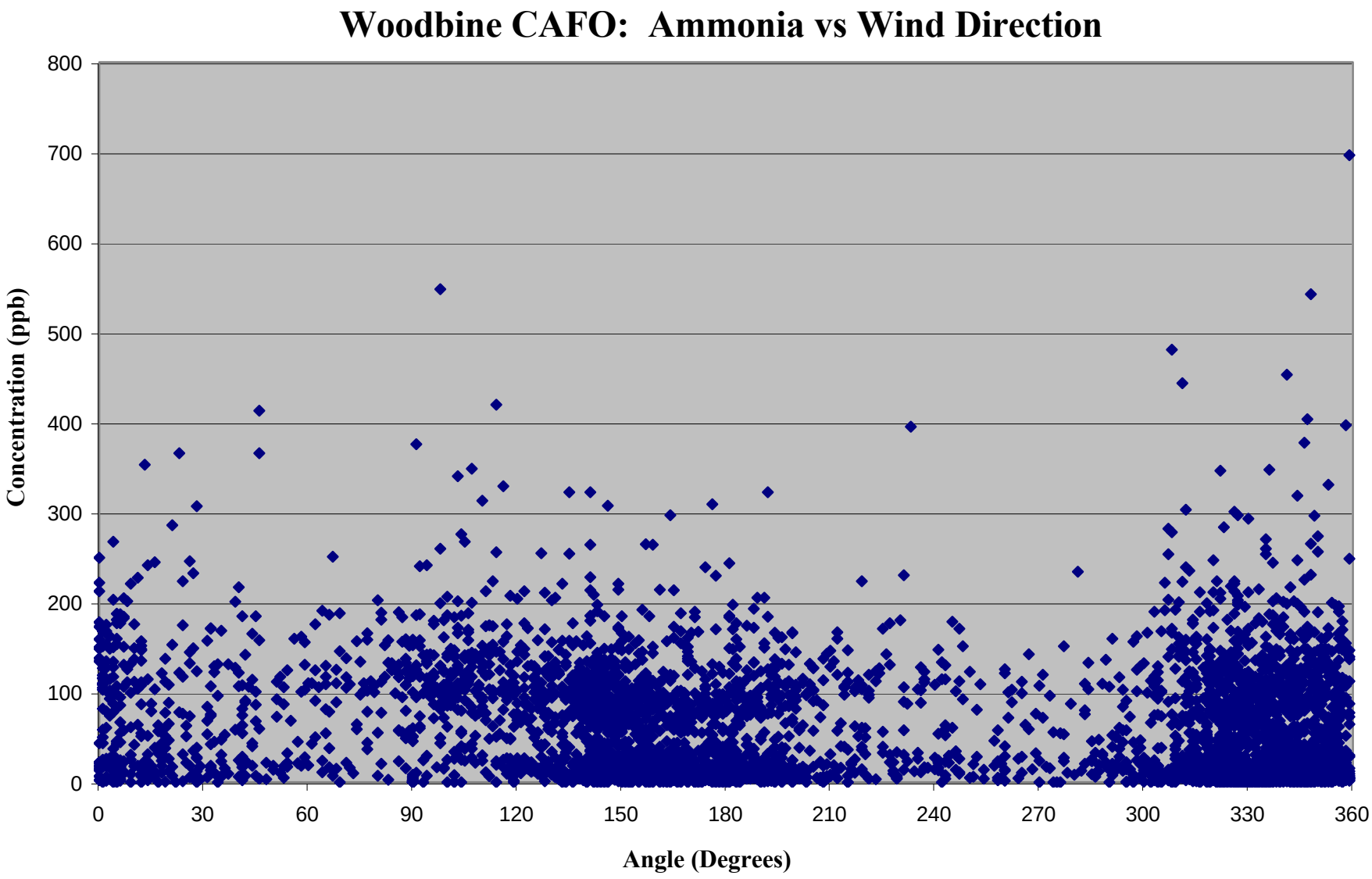
Woodbine CAFO: Hydrogen Sulfide vs Wind Speed

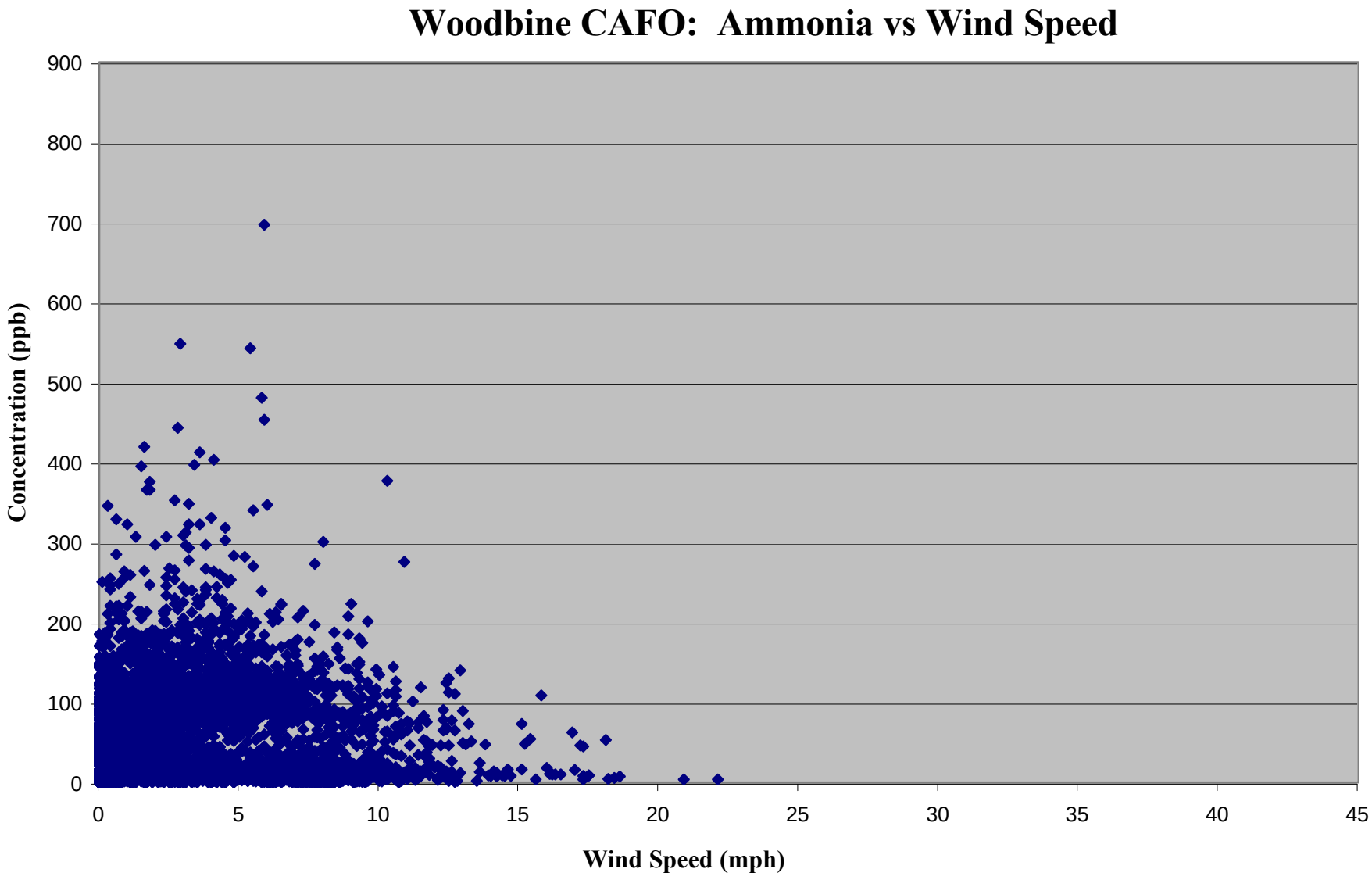
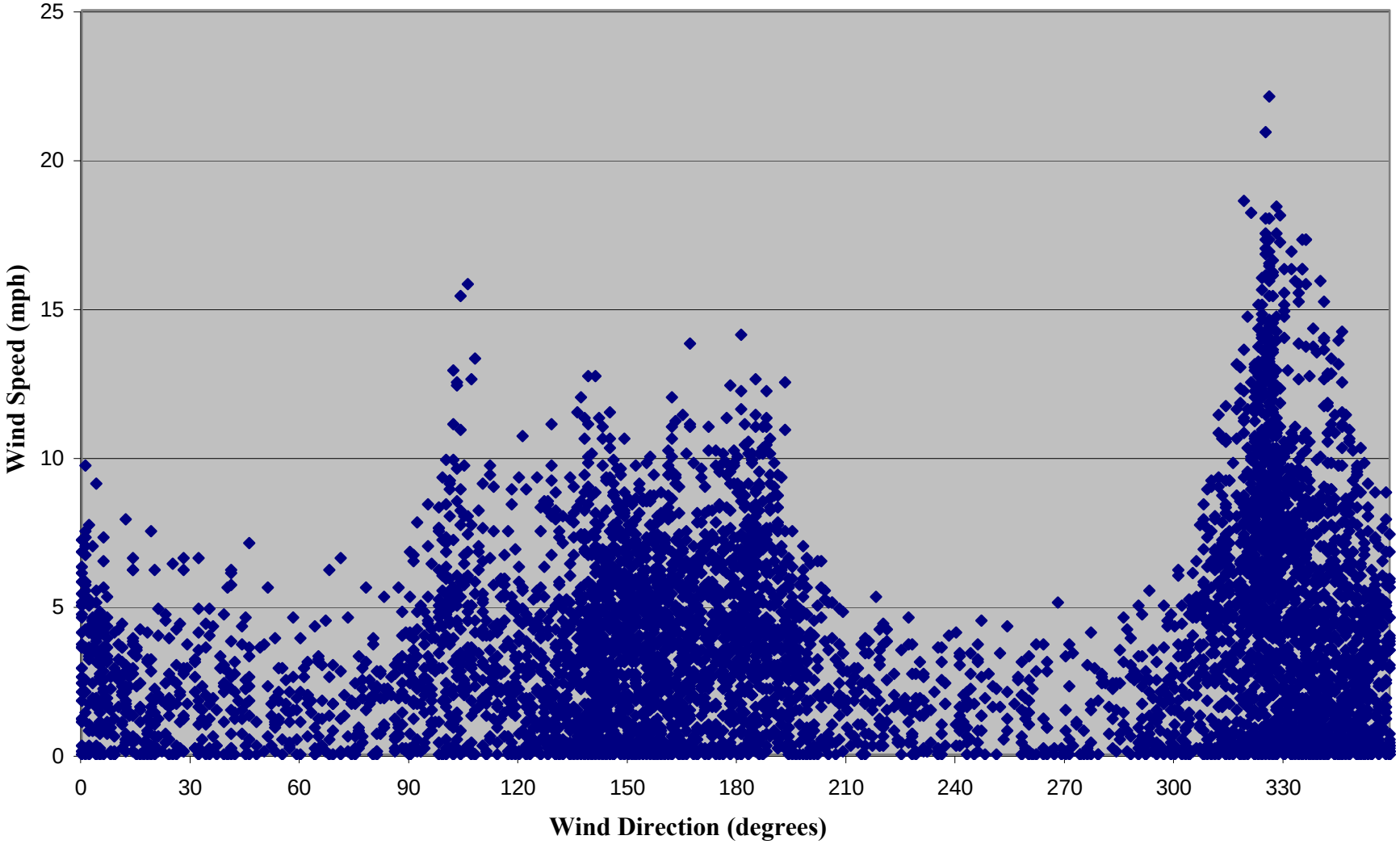


Woodbine CAFO: Ammonia vs Hydrogen Sulfide




Woodbine CAFO: Ammonia vs Time
Concentration (ppb)
800
700
600
500
400
300
200
100
0
1/1/2003
2/1/2003
3/1/2003
4/1/2003
5/1/2003
6/1/2003
7/1/2003
8/1/2003
9/1/2003
10/1/2003
11/1/2003
12/1/2003
Date


Woodbine CAFO: Ammonia vs Wind Direction
Concentration (ppb)
800
700
600
500
400
300
200
100
0
0
30
60
90
120
150
180
210
240
270
300
330
360
Angle (Degrees)


Woodbine CAFO: Ammonia vs Wind Speed
Concentration (ppb)
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
35
40
45
Wind Speed (mph)

Woodbine CAFO: Wind Speed vs Wind Direction