

BILLINGS/LOGAN MT

Latitude = 45.80 N

WMO No. 726770

Longitude = 108.50 W

Elevation = 3570 feet

Period of Record = 1973 to 1996

Average Pressure = 26.27 inches Hg

Design Criteria Data

	Design Value	Mean Coincident (Average) Values			
		Wet Bulb Temperature (°F)	Humidity Ratio (gr/lb)	Wind Speed (mph)	Prevailing Direction (NSEW)
Dry Bulb Temperature (T)	(°F)				
Median of Extreme Highs	99	64	46	10.2	WSW
0.4% Occurrence	94	63	48	9.3	S
1.0% Occurrence	91	62	50	9.7	S
2.0% Occurrence	87	61	51	9.7	NE
Mean Daily Range	21	-	-	-	-
97.5% Occurrence	0	-1	4	9.5	SW
99.0% Occurrence	-7	-8	3	8.4	SW
99.6% Occurrence	-13	-13	2	8.3	SW
Median of Extreme Lows	-17	-17	2	9.8	SW
	Design Value	Mean Coincident (Average) Values			
		Dry Bulb Temperature (°F)	Humidity Ratio (gr/lb)	Wind Speed (mph)	Prevailing Direction (NSEW)
Wet Bulb Temperature (T_{wb})	(°F)				
Median of Extreme Highs	69	88	86	8.6	NE
0.4% Occurrence	66	86	74	9.3	NE
1.0% Occurrence	64	84	67	9.3	NE
2.0% Occurrence	63	83	64	9.3	SW
	Design Value	Mean Coincident (Average) Values			
		Dry Bulb Temperature (°F)	Vapor Pressure (in. Hg)	Wind Speed (mph)	Prevailing Direction (NSEW)
Humidity Ratio (HR)	(gr/lb)				
Median of Extreme Highs	99	76	0.58	8.5	NE
0.4% Occurrence	85	73	0.50	9.2	NNE
1.0% Occurrence	79	71	0.47	8.7	SW
2.0% Occurrence	74	70	0.44	9.0	SW
Air Conditioning/ Humid Area Criteria	# of Hours	T ≥ 93°F	T ≥ 80°F	T _{wb} ≥ 73°F	T _{wb} ≥ 67°F
		55	543	1	29

Other Site Data

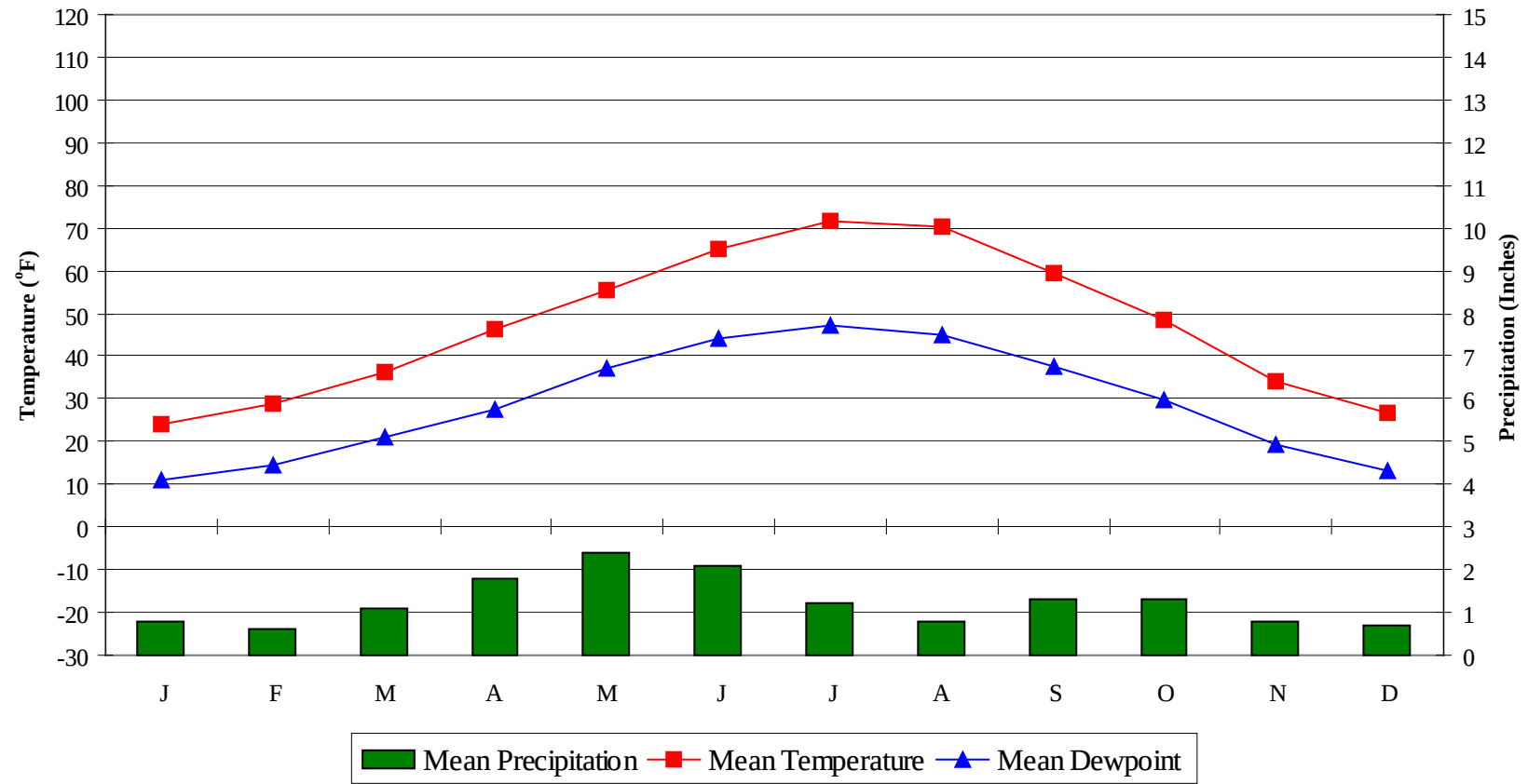
Weather Region	Rain Rate 100 Year Recurrence (in./hr)	Basic Wind Speed 3 sec gust @ 33 ft 50 Year Recurrence (mph)	Ventilation Cooling Load Index (Ton-hr/cfm/yr) Base 75°F-RH 60% Latent + Sensible
5	2.0	90	0.0 + 0.6
Ground Water Temperature (°F) 50 Foot Depth *	Frost Depth 50 Year Recurrence (in.)	Ground Snow Load 50 Year Recurrence (lb/ft ²)	Average Annual Freeze-Thaw Cycles (#)
49.7	N/A	15	77

*Note: Temperatures at greater depths can be estimated by adding 1.5°F per 100 feet additional depth.

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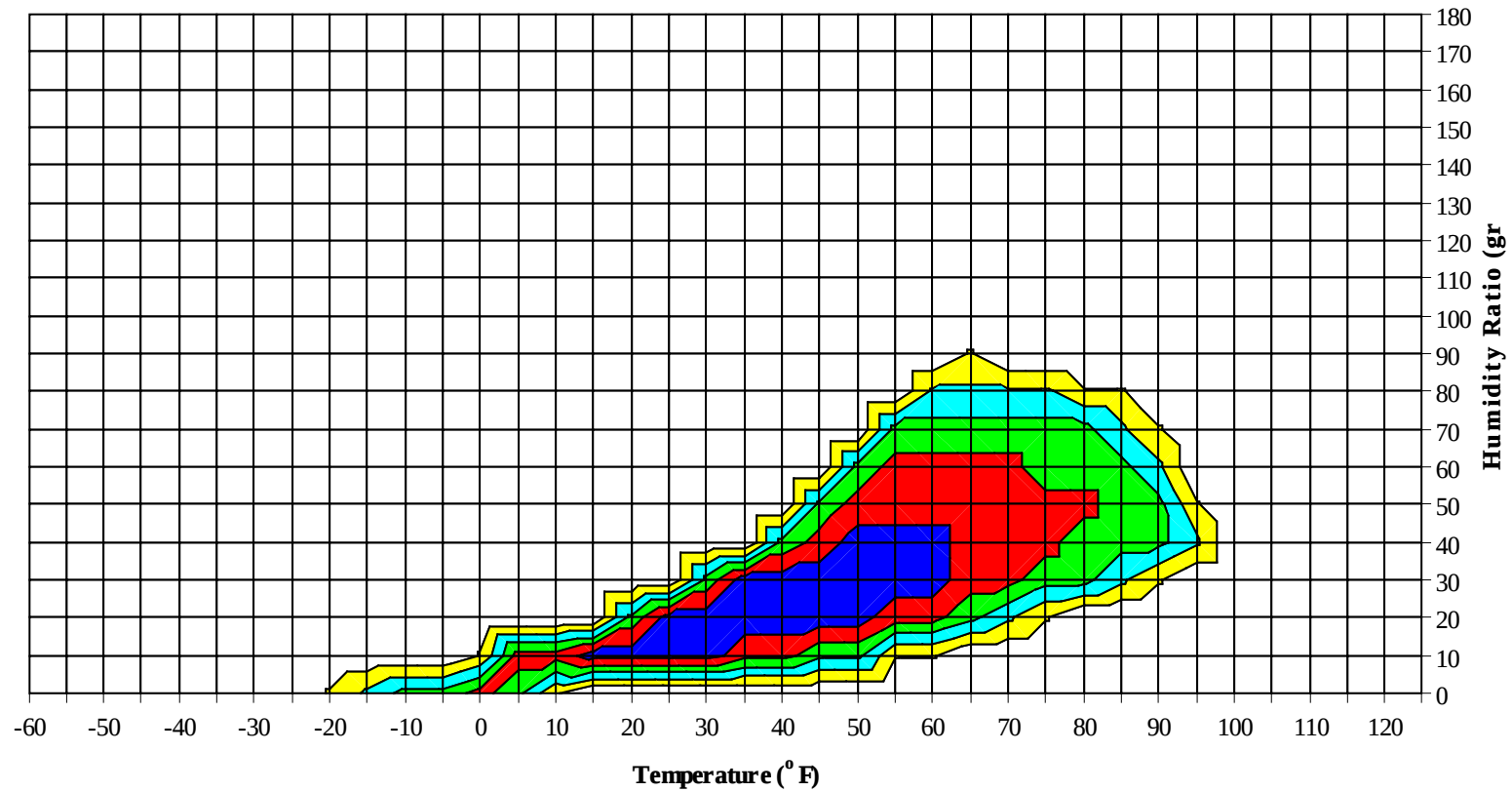
Average Annual Climate



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Long Term Psychrometric Summary

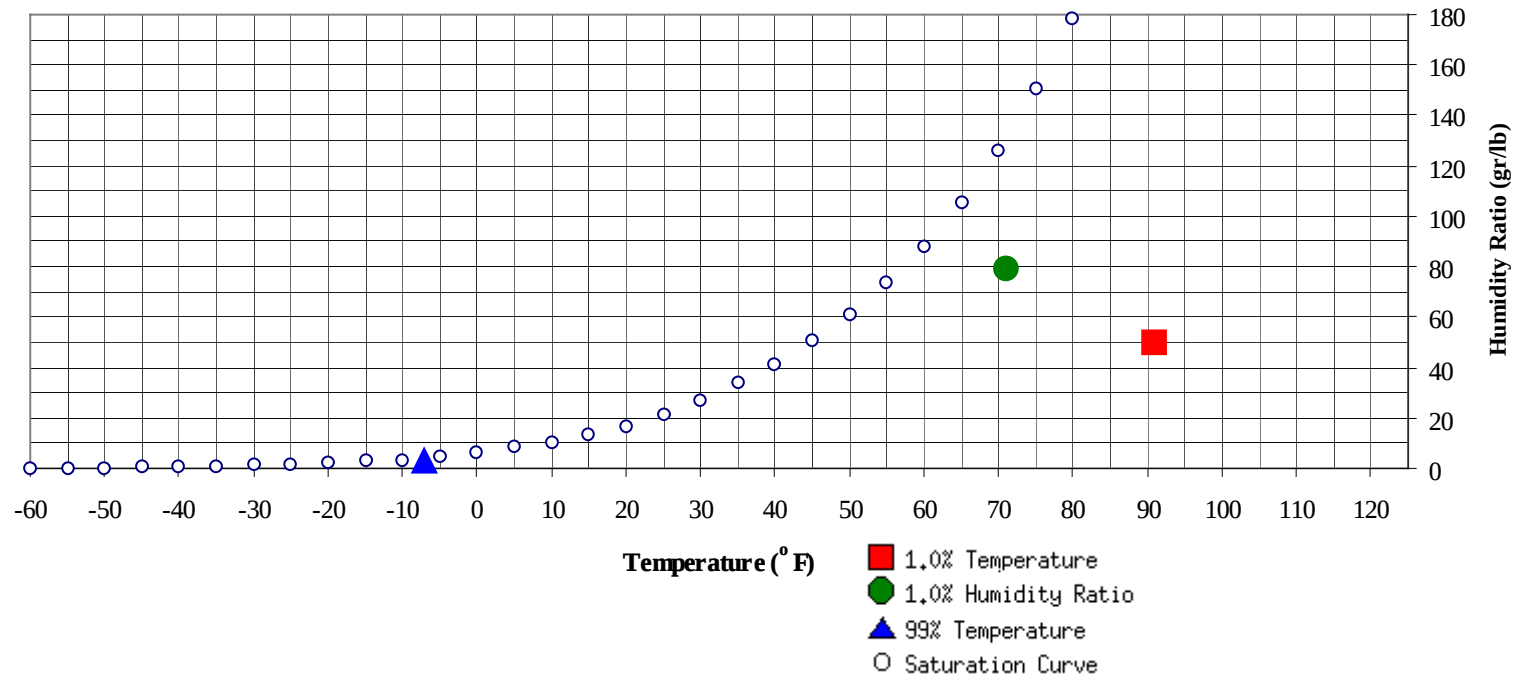


- 50% of all observations
- 80% of all observations
- 95% of all observations
- 97.5% of all observations
- 99% of all observations

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Psychrometric Summary of Peak Design Values



	(°F)	MCHR (gr/lb)	Enthalpy (btu/lb)	1.0% Humidity Ratio	(gr/lb)	MCDB (°F)	MCWB (°F)	MC Dewpt (°F)	Enthalpy (btu/lb)
99% Dry Bulb	-7	2.8	-1.3		79.1	71.1	61.8	57	29.4

	(°F)	MCHR (gr/lb)	MCWB (°F)	Enthalpy (btu/lb)
1.0% Dry Bulb	91	50.3	62.5	29.8

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Dry-Bulb Temperature Hours For An Average Year (Sheet 1 of 5)

Period of Record = 1973 to 1996

Temperature Range (°F)	January					February					March				
	Hour Group (LST)			Total Obs	M C W B (°F)	Hour Group (LST)			Total Obs	M C W B (°F)	Hour Group (LST)			Total Obs	M C W B (°F)
	01 To 08	09 To 16	17 To 00			01 To 08	09 To 16	17 To 00			01 To 08	09 To 16	17 To 00		
100 / 104															
95 / 99															
90 / 94															
85 / 89															
80 / 84															
75 / 79												1	0	1	50.8
70 / 74							0		0	47.7		2	0	2	48.9
65 / 69		0		0	43.0		2	0	2	46.9		5	2	7	46.4
60 / 64		1		1	43.1		3	1	4	44.4	0	13	6	19	44.8
55 / 59	0	4	1	5	42.1		11	4	15	42.0	1	18	11	30	42.3
50 / 54	1	10	4	15	39.3	2	19	11	32	39.5	4	30	20	54	39.7
45 / 49	6	22	13	40	36.6	8	20	20	49	36.6	10	33	32	75	37.4
40 / 44	18	28	26	71	33.7	20	31	30	81	33.7	29	37	40	106	34.7
35 / 39	30	33	34	97	30.5	31	31	37	99	30.7	46	33	44	123	31.8
30 / 34	35	31	37	103	27.2	42	24	33	99	27.7	61	30	41	132	28.7
25 / 29	36	24	32	92	23.4	32	16	20	67	23.9	43	19	23	84	24.6
20 / 24	28	20	19	67	19.6	21	12	12	46	19.6	24	10	13	47	20.1
15 / 19	19	13	13	45	15.1	14	13	11	37	15.2	11	5	4	21	15.6
10 / 14	14	13	13	40	10.3	14	11	12	37	10.5	6	4	5	16	10.8
5 / 9	13	14	15	42	5.6	10	9	11	29	5.8	4	3	4	11	6.1
0 / 4	20	18	18	55	0.9	11	10	9	31	0.9	4	2	3	10	1.3
-5 / -1	12	8	11	31	-3.2	7	5	6	18	-3.1	3	1	1	5	-3.1
-10 / -6	10	6	9	24	-7.4	7	3	4	14	-7.6	1	0	0	2	-7.6
-15 / -11	5	3	3	11	-12.3	3	1	1	6	-12.7	1	0	0	1	-11.1
-20 / -16	3	1	1	5	-16.7	1	1	0	2	-17.0	0			0	-15.8
-25 / -21	0			0	-20.3	1	1	1	2	-21.8					
-30 / -26						1	0	0	1	-25.5					
-35 / -31															

Caution: This summary reflects the typical distribution of temperature in a typical year. It does not reflect the typical moisture distribution. Because wet bulb temperatures are averaged, this summary understates the annual moisture load. For accurate moisture load data, see the long-term humidity summary and the ventilation and infiltration load pages in this manual.

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Dry-Bulb Temperature Hours For An Average Year (Sheet 2 of 5)

Period of Record = 1973 to 1996

Temperature Range (°F)	April					May					June				
	Hour Group (LST)			Total Obs	M C W B (°F)	Hour Group (LST)			Total Obs	M C W B (°F)	Hour Group (LST)			Total Obs	M C W B (°F)
	01 To 08	09 To 16	17 To 00			01 To 08	09 To 16	17 To 00			01 To 08	09 To 16	17 To 00		
100 / 104												1	0	1	65.6
95 / 99												3	1	4	63.7
90 / 94							1	0	1	59.9		11	5	16	62.9
85 / 89		1	0	1	56.0		5	2	6	58.8		17	10	27	61.6
80 / 84		3	1	4	54.6		12	5	17	56.9	0	26	16	43	60.4
75 / 79		7	3	10	52.9		18	9	27	55.8	2	38	25	65	58.3
70 / 74	0	13	7	20	50.7	0	30	17	47	54.1	8	43	36	87	56.4
65 / 69	0	20	12	32	48.7	4	37	24	65	51.9	24	41	38	103	54.7
60 / 64	2	24	19	46	46.2	13	39	38	90	49.7	45	31	42	118	52.6
55 / 59	9	29	26	64	43.9	32	38	43	112	47.4	64	16	36	117	50.3
50 / 54	20	36	34	89	41.5	57	30	45	132	45.1	56	8	21	85	46.8
45 / 49	35	33	38	106	38.9	63	20	35	118	42.0	30	3	8	41	43.3
40 / 44	43	28	37	108	36.0	47	11	18	76	38.2	9	1	2	12	39.8
35 / 39	57	20	33	110	32.9	23	6	9	37	34.2	1	0	0	1	37.2
30 / 34	46	15	18	79	29.5	9	2	3	15	30.8					
25 / 29	15	5	8	28	25.1	1	0	0	1	27.5					
20 / 24	10	3	5	17	20.5										
15 / 19	3	1	0	5	16.7										
10 / 14	0	0		0	12.8										
5 / 9															
0 / 4															
-5 / -1															
-10 / -6															
-15 / -11															
-20 / -16															
-25 / -21															
-30 / -26															
-35 / -31															

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Dry-Bulb Temperature Hours For An Average Year (Sheet 3 of 5)

Period of Record = 1973 to 1996

Temperature Range (°F)	July					August					September				
	Hour Group (LST)			Total Obs	M C W B (°F)	Hour Group (LST)			Total Obs	M C W B (°F)	Hour Group (LST)			Total Obs	M C W B (°F)
	01 To 08	09 To 16	17 To 00			01 To 08	09 To 16	17 To 00			01 To 08	09 To 16	17 To 00		
100 / 104		1	1	2	63.9		1	0	1	64.6		0	0	0	63.8
95 / 99		9	4	13	63.7		6	2	8	63.8		0	0	1	62.5
90 / 94		25	12	37	63.0		23	9	32	62.1		4	1	5	60.3
85 / 89	0	37	22	59	62.2		32	19	51	61.1		11	4	15	59.1
80 / 84	1	50	36	86	60.6	1	45	33	78	59.7	0	20	9	30	57.2
75 / 79	6	46	42	93	59.0	4	44	39	88	58.3	0	26	17	44	55.7
70 / 74	25	40	46	111	57.6	21	41	48	110	56.5	4	33	27	65	53.8
65 / 69	57	21	39	117	56.0	43	28	40	112	54.8	9	32	35	77	51.9
60 / 64	80	10	28	119	53.9	78	17	33	129	53.0	26	36	40	102	49.8
55 / 59	58	6	13	76	51.8	59	8	16	83	50.5	47	28	37	113	47.5
50 / 54	20	2	5	27	49.0	30	2	7	39	47.2	60	22	30	112	45.1
45 / 49	2	0	0	2	45.3	9	1	1	11	43.7	45	12	21	78	41.9
40 / 44						2	0	1	3	39.3	30	6	10	45	38.5
35 / 39						0	0		0	35.9	13	4	5	21	34.8
30 / 34											4	2	2	8	30.6
25 / 29											2	1	1	4	26.2
20 / 24											0	0	0	1	23.2
15 / 19															
10 / 14															
5 / 9															
0 / 4															
-5 / -1															
-10 / -6															
-15 / -11															
-20 / -16															
-25 / -21															
-30 / -26															
-35 / -31															

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Dry-Bulb Temperature Hours For An Average Year (Sheet 4 of 5)

Period of Record = 1973 to 1996

Temperature Range (°F)	October					November					December				
	Hour Group (LST)			Total Obs	M C W B (°F)	Hour Group (LST)			Total Obs	M C W B (°F)	Hour Group (LST)			Total Obs	M C W B (°F)
	01 To 08	09 To 16	17 To 00			01 To 08	09 To 16	17 To 00			01 To 08	09 To 16	17 To 00		
100 / 104															
95 / 99															
90 / 94															
85 / 89		1	0	1	56.9										
80 / 84		5	1	5	55.1										
75 / 79		8	2	11	53.2		0		0	54.5					
70 / 74	0	17	7	25	51.0		2	0	2	50.4					
65 / 69	1	24	13	38	49.2		4	1	5	48.2		0		0	46.3
60 / 64	4	29	25	58	47.1	1	9	3	12	45.8		2	0	2	44.8
55 / 59	15	35	34	85	44.5	2	13	7	23	43.1	1	5	1	7	42.4
50 / 54	35	38	42	114	42.2	9	24	18	51	40.5	3	10	6	19	39.5
45 / 49	45	34	41	120	39.8	18	30	24	72	37.6	8	19	13	41	36.7
40 / 44	57	21	35	114	36.6	26	35	34	95	34.4	17	31	23	71	33.6
35 / 39	39	15	22	77	33.3	38	32	40	110	31.2	27	35	37	99	30.5
30 / 34	28	11	15	55	29.7	50	29	41	119	28.1	40	38	45	124	27.2
25 / 29	13	4	6	23	25.2	33	20	25	78	24.3	43	29	34	107	23.5
20 / 24	7	2	3	12	21.2	21	11	15	47	20.1	35	21	26	83	19.6
15 / 19	1	1	1	4	16.4	13	9	10	32	15.7	21	14	17	52	15.4
10 / 14	1	1	0	2	11.0	11	7	9	27	11.0	15	11	12	38	10.8
5 / 9	0	0	0	1	6.4	7	5	4	15	6.5	11	9	8	29	6.1
0 / 4	0	0	0	0	1.5	5	4	4	13	1.5	9	7	7	23	1.1
-5 / -1	0	0		0	-3.6	2	2	3	7	-3.2	4	3	4	12	-3.0
-10 / -6	0			0	-6.7	3	2	3	8	-7.1	4	5	5	14	-7.7
-15 / -11						1	1	1	3	-11.5	5	4	4	13	-12.3
-20 / -16						1		0	1	-16.2	3	2	3	8	-17.1
-25 / -21											2	0	1	3	-21.3
-30 / -26											0	0	0	1	-26.1
-35 / -31											0	0		0	-30.7

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Dry-Bulb Temperature Hours For An Average Year (Sheet 5 of 5)**Period of Record = 1973 to 1996**

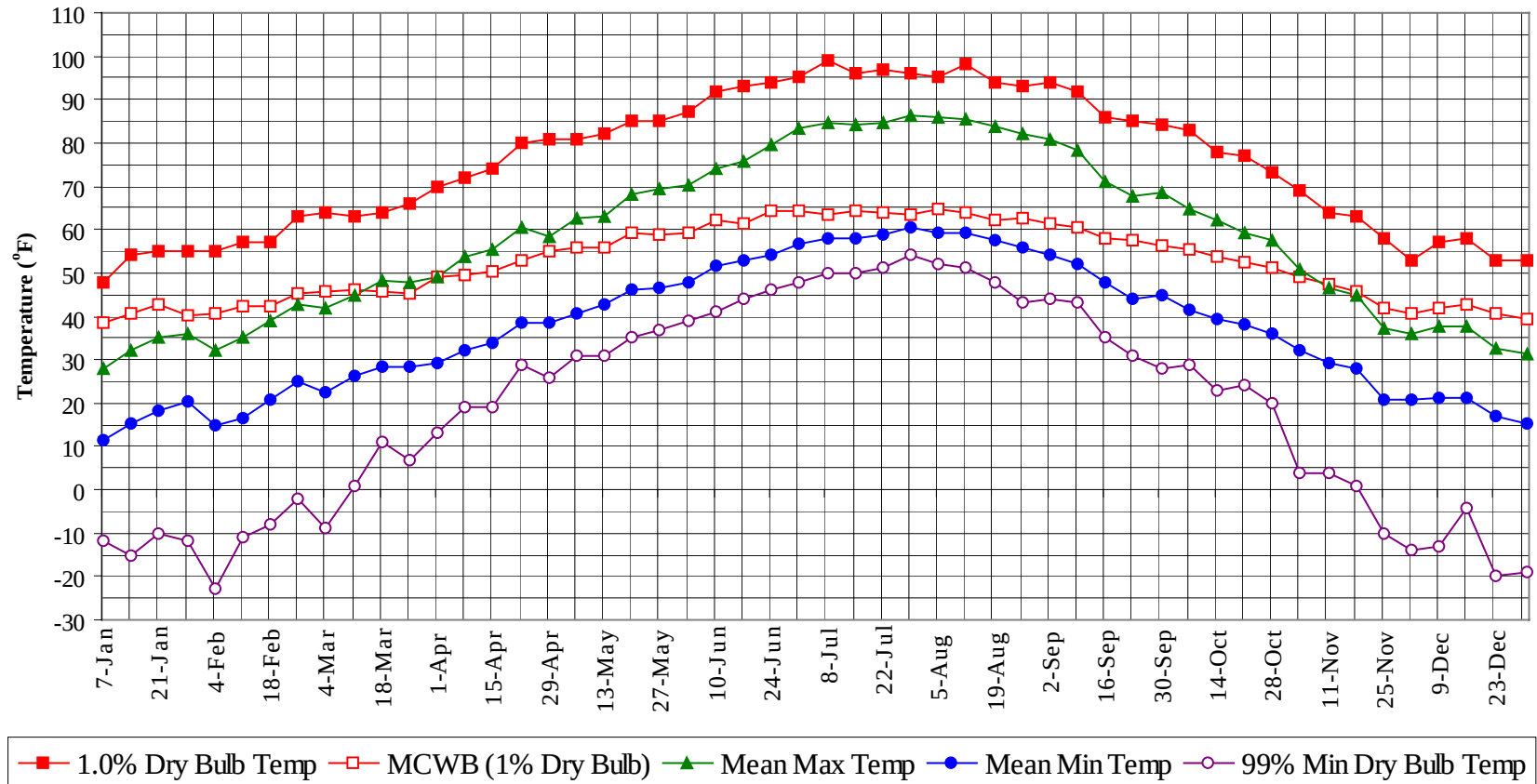
Temperature Range (°F)	Annual Totals				
	Hour Group (LST)			Total Obs	M C W B (°F)
	01 To 08	09 To 16	17 To 00		
100 / 104		3	1	4	64.5
95 / 99		19	7	25	63.7
90 / 94		63	28	91	62.5
85 / 89	0	105	57	161	61.3
80 / 84	2	160	101	263	59.5
75 / 79	12	187	138	338	57.6
70 / 74	59	220	189	467	55.5
65 / 69	140	213	203	556	53.4
60 / 64	250	213	234	696	50.8
55 / 59	287	211	227	725	47.5
50 / 54	293	231	240	763	43.5
45 / 49	276	228	245	748	39.5
40 / 44	296	231	255	783	35.5
35 / 39	304	210	263	778	31.7
30 / 34	317	183	236	737	28.2
25 / 29	220	119	149	489	24.0
20 / 24	147	81	95	322	19.8
15 / 19	83	56	58	197	15.4
10 / 14	61	48	51	161	10.7
5 / 9	45	41	42	128	5.9
0 / 4	49	42	43	134	1.0
-5 / -1	29	20	25	74	-3.2
-10 / -6	26	16	21	63	-7.5
-15 / -11	15	9	10	33	-12.3
-20 / -16	8	4	4	16	-16.9
-25 / -21	3	1	2	6	-21.4
-30 / -26	1	0	0	2	-25.7
-35 / -31	0	0		0	-30.7

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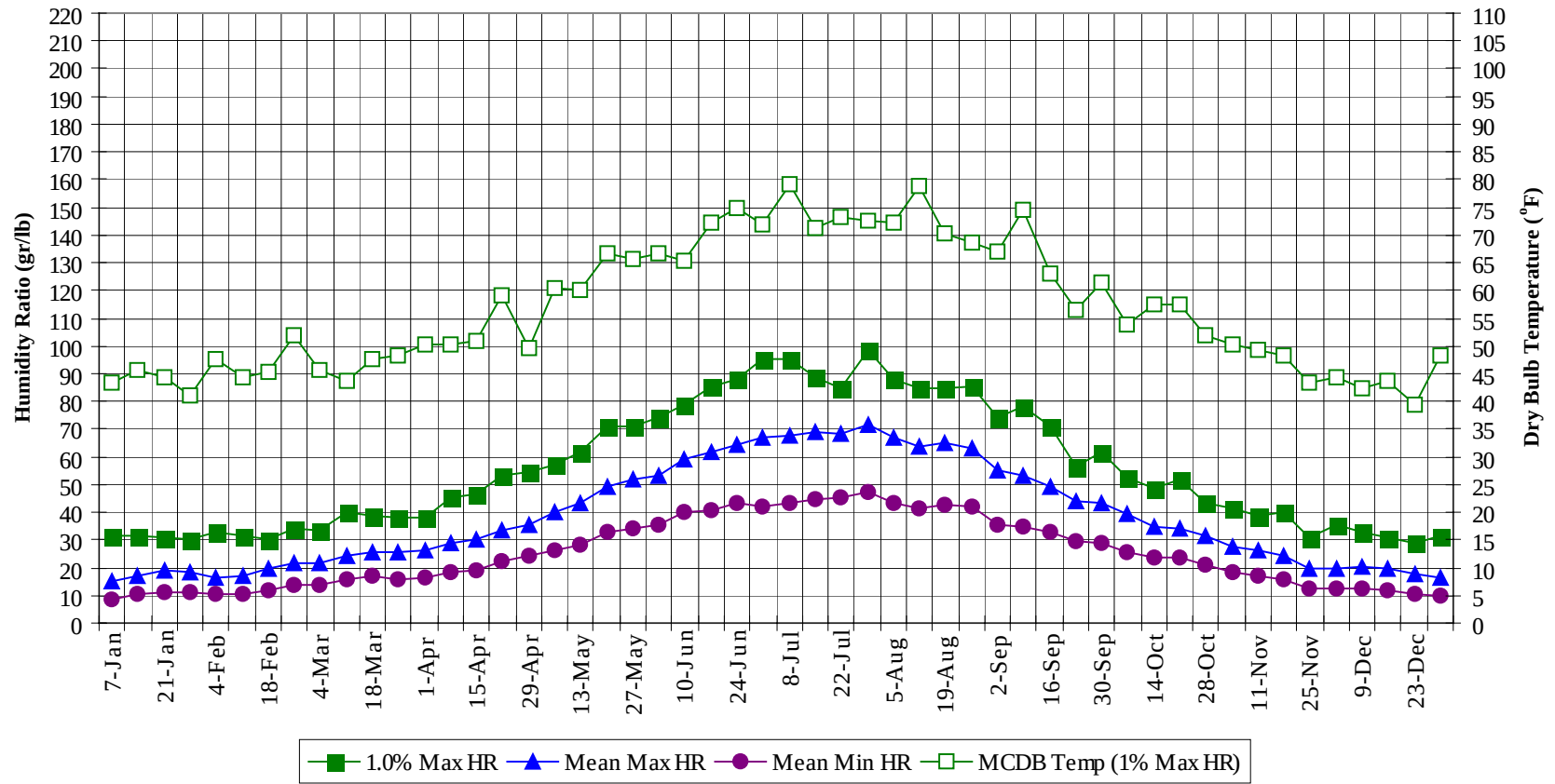
Annual Summary of Temperatures



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Long Term Humidity and Dry Bulb Temperature Summary



BILLINGS/LOGAN MT

WMO No. 726770

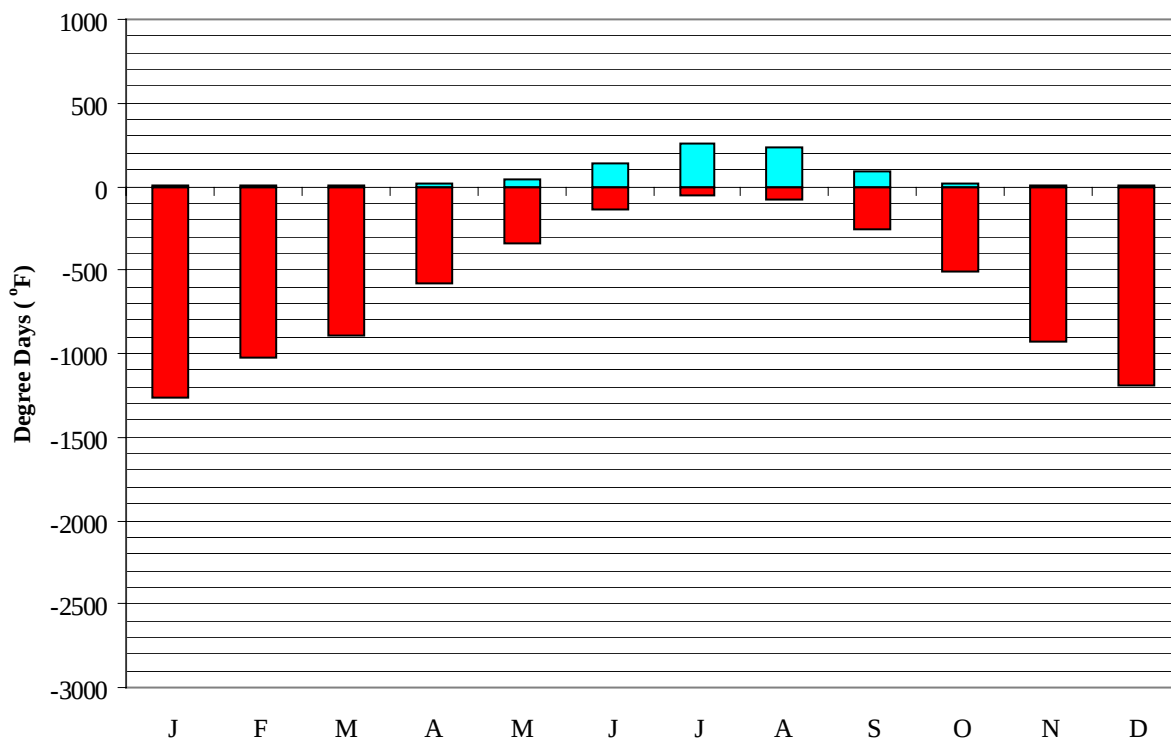
Long Term Dry Bulb Temperature and Humidity Summary

Week Ending	1.0% Temp (°F)	MCWB @ 1% Temp (°F)	Mean Max Temp (°F)	Mean Min Temp (°F)	99% Temp (°F)	1.0% HR (gr/lb)	MCDB @ 1% HR (°F)	Mean Max HR (gr/lb)	Mean Min HR (gr/lb)
7-Jan	48.0	38.4	28.0	11.4	-12.0	31.5	43.4	15.4	8.6
14-Jan	54.0	40.8	32.1	15.4	-15.0	31.5	45.6	17.1	10.2
21-Jan	55.0	42.9	34.9	18.0	-10.0	30.8	44.5	19.0	11.2
28-Jan	55.0	40.3	36.2	20.3	-12.0	30.1	41.2	18.1	11.2
4-Feb	55.0	40.6	32.1	14.9	-23.0	32.9	47.7	16.7	10.3
11-Feb	57.0	42.5	35.0	16.4	-11.0	31.5	44.3	17.4	10.4
18-Feb	57.0	42.4	39.1	20.8	-8.0	30.1	45.2	20.0	12.1
25-Feb	63.0	45.3	42.7	25.1	-2.0	34.3	51.8	21.5	13.9
4-Mar	64.0	45.7	42.0	22.4	-9.0	33.6	45.7	21.5	13.7
11-Mar	63.0	46.1	44.8	26.3	1.0	39.9	43.7	24.5	15.9
18-Mar	64.0	45.8	48.1	28.5	11.0	38.5	47.6	25.4	17.0
25-Mar	66.0	45.3	47.8	28.4	7.0	37.8	48.3	25.7	15.8
1-Apr	70.0	49.0	49.0	29.2	13.0	37.8	50.2	26.0	16.7
8-Apr	72.0	49.5	53.9	32.2	19.0	45.5	50.1	28.7	18.1
15-Apr	74.0	50.3	55.4	33.9	19.0	46.9	50.9	30.5	19.3
22-Apr	80.0	53.0	60.6	38.5	29.0	53.2	59.1	33.8	22.5
29-Apr	81.0	55.0	58.5	38.3	26.0	54.6	49.7	35.7	24.0
6-May	81.0	55.7	62.8	40.6	31.0	57.4	60.5	40.1	26.0
13-May	82.0	55.7	63.0	42.7	31.0	61.6	60.2	43.5	28.3
20-May	85.0	59.3	67.9	46.1	35.0	70.7	66.5	49.3	33.2
27-May	85.0	58.8	69.4	46.5	37.0	70.7	65.8	51.7	34.1
3-Jun	87.0	59.4	70.3	47.8	39.0	74.2	66.7	53.1	35.6
10-Jun	92.0	62.1	74.2	51.7	41.0	79.1	65.5	59.3	40.3
17-Jun	93.0	61.3	75.6	52.8	44.0	85.4	72.4	61.8	40.6
24-Jun	94.0	64.4	79.7	54.0	46.0	88.2	75.0	64.2	43.2
1-Jul	95.0	64.4	83.2	56.7	48.0	95.2	72.1	66.7	42.0
8-Jul	99.0	63.4	84.6	57.9	50.0	95.2	79.2	67.7	43.2
15-Jul	96.0	64.1	84.1	58.1	50.0	88.9	71.4	69.0	44.7
22-Jul	97.0	64.0	84.7	58.7	51.0	84.7	73.1	68.5	45.1
29-Jul	96.0	63.6	86.2	60.4	54.0	98.7	72.6	71.6	47.0
5-Aug	95.0	64.6	85.8	59.2	52.0	88.2	72.4	66.8	43.7
12-Aug	98.0	63.7	85.6	59.2	51.0	84.7	78.9	63.9	41.4
19-Aug	94.0	62.1	83.6	57.5	48.0	84.7	70.2	65.0	42.4
26-Aug	93.0	62.6	82.1	55.8	43.0	85.4	68.6	63.0	41.9
2-Sep	94.0	61.5	80.7	54.0	44.0	74.2	67.1	55.2	35.7
9-Sep	92.0	60.3	78.3	52.1	43.0	78.4	74.4	53.3	34.5
16-Sep	86.0	58.2	71.3	47.8	35.0	70.7	63.0	49.0	33.0
23-Sep	85.0	57.7	67.8	44.2	31.0	56.7	56.4	43.7	29.4
30-Sep	84.0	56.4	68.5	44.7	28.0	61.6	61.3	43.4	28.6
7-Oct	83.0	55.3	64.6	41.4	29.0	52.5	53.9	39.1	25.7
14-Oct	78.0	53.9	62.0	39.4	23.0	48.3	57.3	35.0	23.6
21-Oct	77.0	52.6	59.3	38.1	24.0	51.8	57.5	34.2	23.5
28-Oct	73.0	51.0	57.6	36.0	20.0	43.4	52.0	31.3	21.0
4-Nov	69.0	49.3	50.9	32.0	4.0	41.3	50.3	27.5	18.3
11-Nov	64.0	47.6	46.7	29.1	4.0	38.5	49.1	26.5	16.8
18-Nov	63.0	45.7	45.0	28.0	1.0	39.9	48.2	24.5	15.9
25-Nov	58.0	42.0	37.2	20.8	-10.0	30.8	43.4	19.5	12.3
2-Dec	53.0	40.7	36.1	20.6	-14.0	35.7	44.3	20.0	12.3
9-Dec	57.0	41.9	37.5	21.2	-13.0	32.9	42.5	20.4	12.4
16-Dec	58.0	42.8	37.9	21.2	-4.0	30.8	43.8	19.9	11.5
23-Dec	53.0	40.7	32.5	16.8	-20.0	28.7	39.6	17.6	10.6
31-Dec	53.0	39.2	31.3	15.2	-19.0	31.5	48.1	16.1	9.9

BILLINGS/LOGAN MT

WMO No. 726770

Degree Days, Heating and Cooling
(Base 65°F)



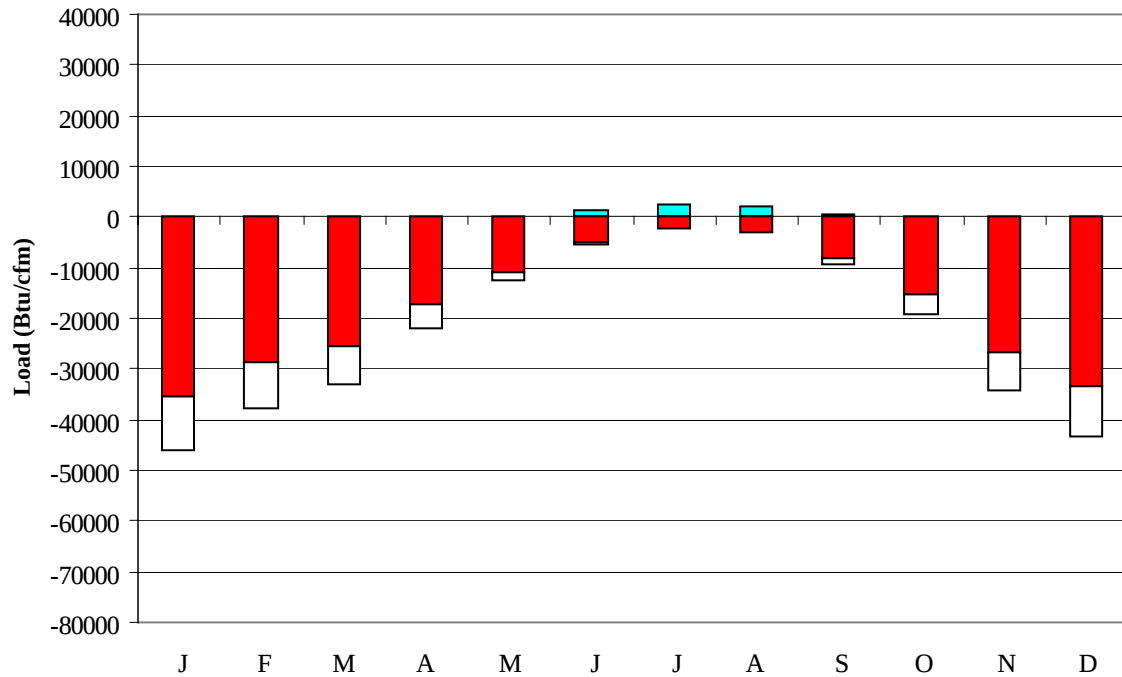
Mean Cooling Degree Days Mean Heating Degree Days

	Mean Cooling Degree Days (°F)	Mean Heating Degree Days (°F)
JAN	0	1265
FEB	0	1026
MAR	1	892
APR	16	579
MAY	47	347
JUN	143	139
JUL	262	54
AUG	232	73
SEP	86	255
OCT	19	513
NOV	1	934
DEC	0	1189
ANN	807	7266

BILLINGS/LOGAN MT

WMO No. 726770

Average Ventilation and Infiltration Loads
(Outside Air vs. 75°F, 60% RH summer; 68°F, 30% RH winter)

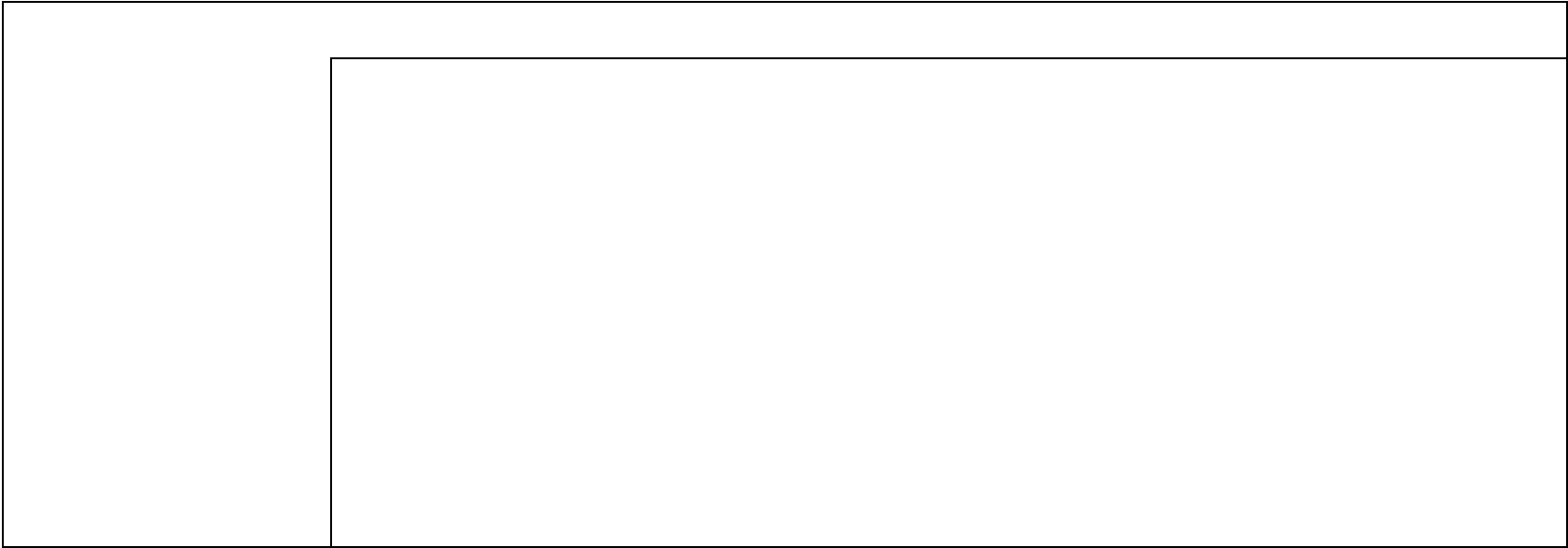


■ Average Sensible Cooling Load ■ Average Sensible Heating Load
■ Average Latent Cooling (Drying) Load Average Latent Heating (Humidifying) Load

	Average Sensible Cooling Load (Btu/cfm)	Average Sensible Heating Load (Btu/cfm)	Average Latent Cooling Load (Btu/cfm)	Average Latent Heating Load (Btu/cfm)
JAN	0	-35206	0	-10723
FEB	0	-28774	0	-8911
MAR	1	-25506	0	-7540
APR	52	-17189	0	-4679
MAY	249	-10961	0	-1527
JUN	1159	-4934	22	-331
JUL	2562	-2291	56	-133
AUG	2146	-2878	5	-224
SEP	585	-8284	0	-1245
OCT	67	-15408	0	-3790
NOV	0	-26526	0	-7826
DEC	0	-33234	0	-10213
ANN	6821	-211191	83	-57142

Average Annual Solar Radiation – Nearest Available Site
(Source: National Renewable Energy Laboratory, Golden CO, 1995)

No Solar Radiation
Data Available

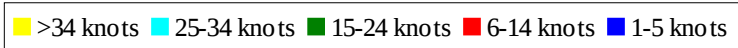
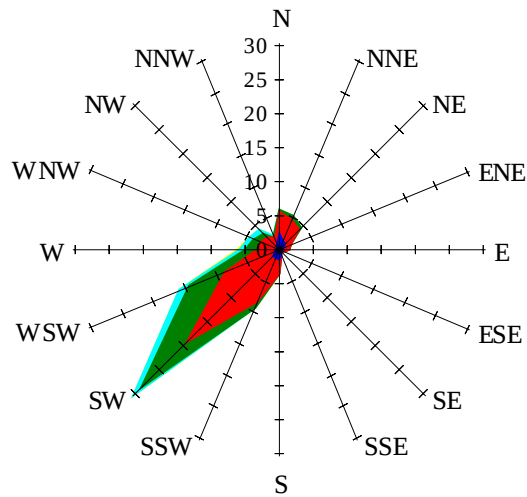


Average Annual Solar Heat and Illumination – Nearest Available Site

(Source: National Renewable Energy Laboratory, Golden CO, 1995)

Wind Summary - December, January, and February

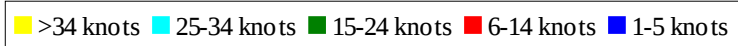
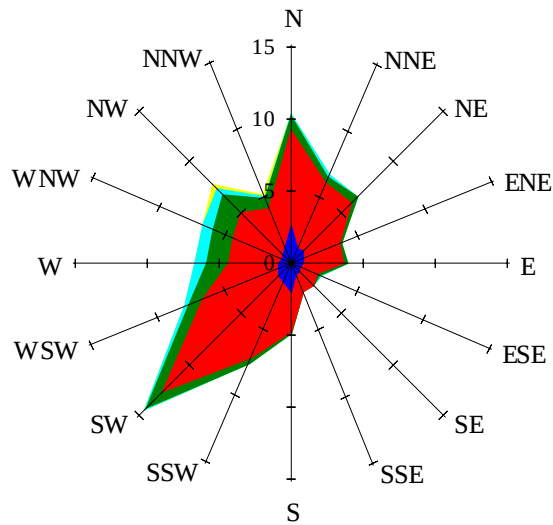
Labels of Percent Frequency on North Axis



Percent Calm = 3.19

Wind Summary - March, April, and May

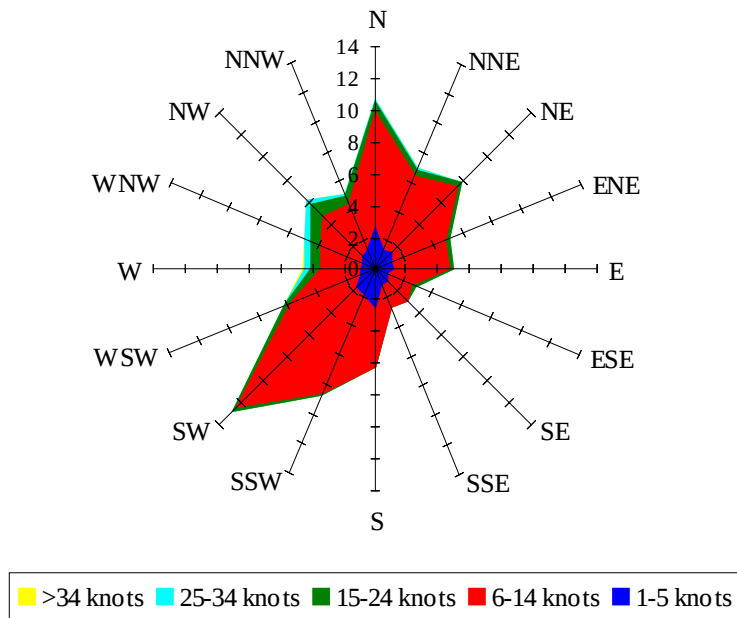
Labels of Percent Frequency on North Axis



Percent Calm = 2.71

Wind Summary - June, July, and August

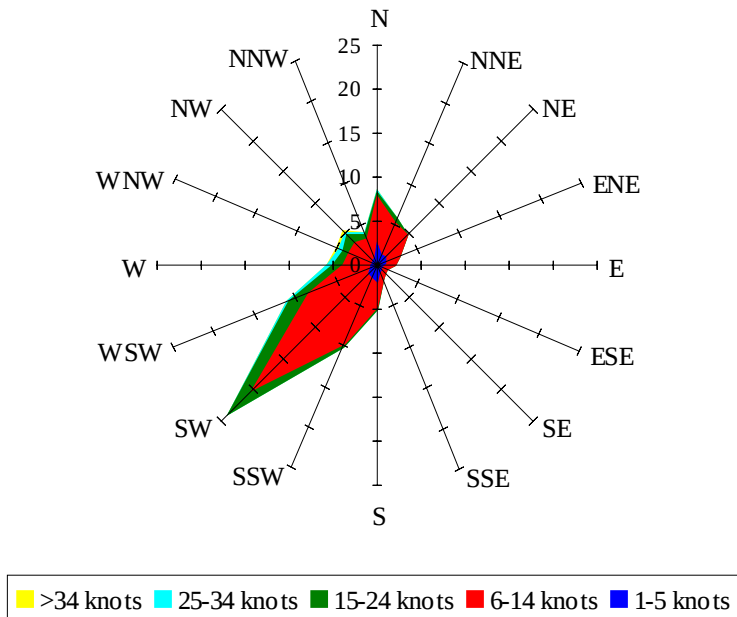
Labels of Percent Frequency on North Axis



Percent Calm = 2.80

Wind Summary - September, October, and November

Labels of Percent Frequency on North Axis



Percent Calm = 2.80