

Precipitation Data

Data compiled from past annual reports between 2005 – 2016.

Precipitation controls surface runoff and is arguably the greatest factor controlling surface water quality. Water quality in the MWMO reach of the Mississippi River is affected by precipitation in the entire Mississippi River basin upstream of the MWMO, including tributary watersheds to the river.

2005

The following graph shows precipitation for six locations along the Mississippi River: two in the watershed (Lower Saint Anthony Falls and Lock & Dam 1) and four between St. Cloud and the MWMO northern boundary (Figure 1). Precipitation for the watershed only is shown in Figure 2. The MWMO acknowledges a link between precipitation and the water quality data shown in the following sections. However, the MWMO does not support quantitative analysis of this relationship because precipitation data are not representative of the entire Mississippi River basin contributing to the MWMO watershed.

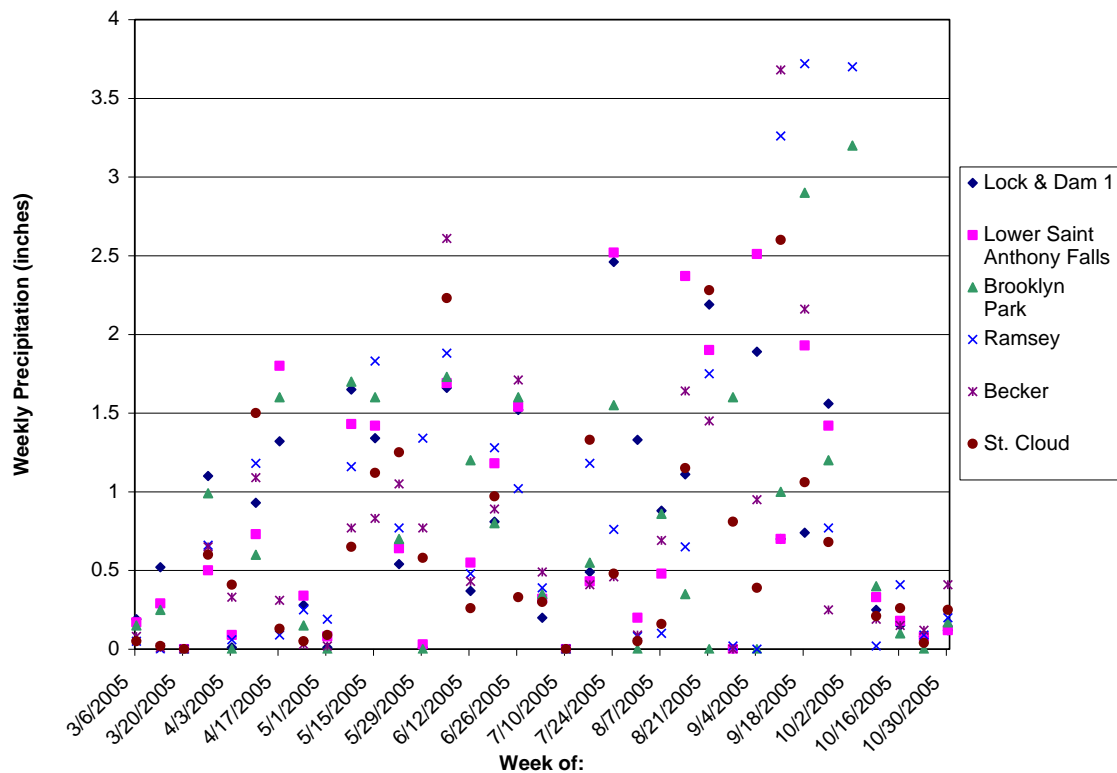


Figure 1. Precipitation for six locations along the Mississippi River. Precipitation values greater than 4 inches were omitted to improve the scale of the graph. Missing data for 9/4/05 includes 4.58 inches at Brooklyn Park and 4.52 inches at Ramsey. Missing data for 10/2/05 includes: 5.21 inches at Lock & Dam 1, 4.34 inches at Lower Saint Anthony Falls, 4.18 inches at Becker and 4.13 inches at St. Cloud.

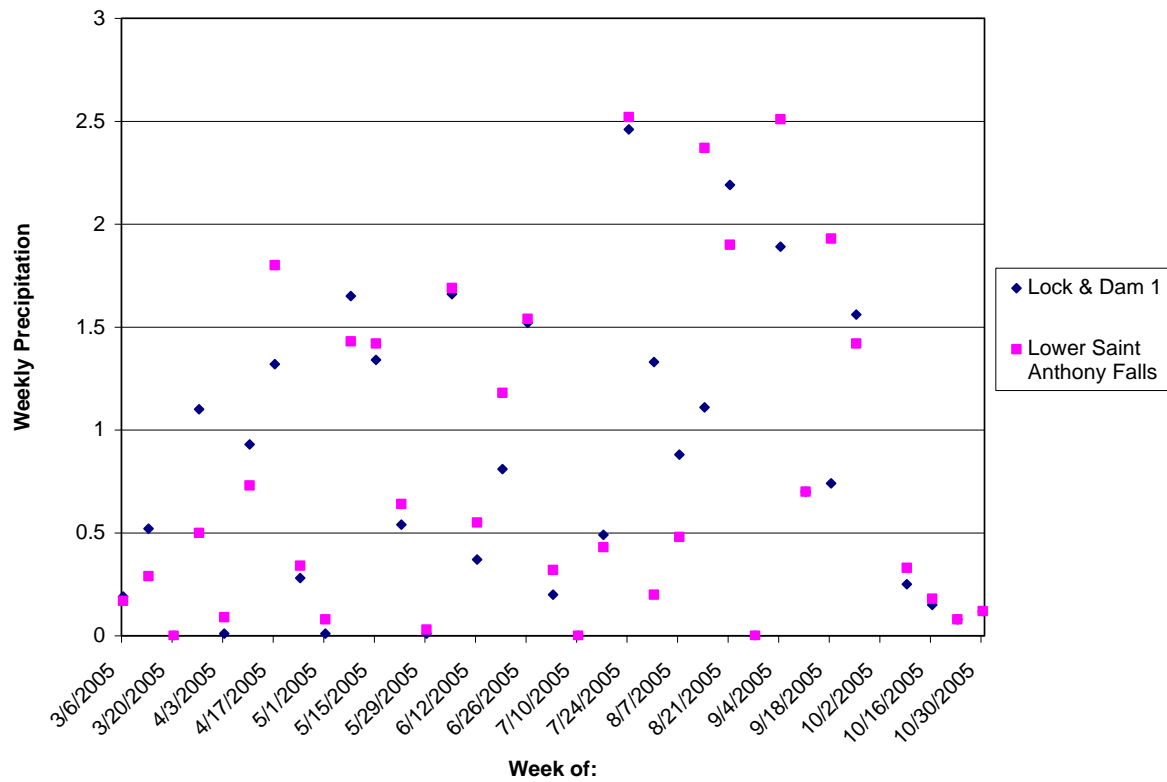


Figure 2. Precipitation for two locations in the MWMO watershed. Precipitation values greater than 4 inches were omitted to improve the scale of the graph. Missing data for 10/2/05 includes: 5.21 inches at Lock & Dam 1 and 4.34 inches at Lower Saint Anthony Falls.

2006

The following graph shows precipitation for six locations along the Mississippi River: two in the watershed (Lower Saint Anthony Falls and Lock & Dam 1) and four between St. Cloud and the MWMO northern boundary (Figure 3). Precipitation for the watershed only is shown in Figure 4. The MWMO acknowledges a link between precipitation and the water quality data shown in the following sections. However, the MWMO does not support quantitative analysis of this relationship because precipitation data are not representative of the entire Mississippi River basin contributing to the MWMO watershed.

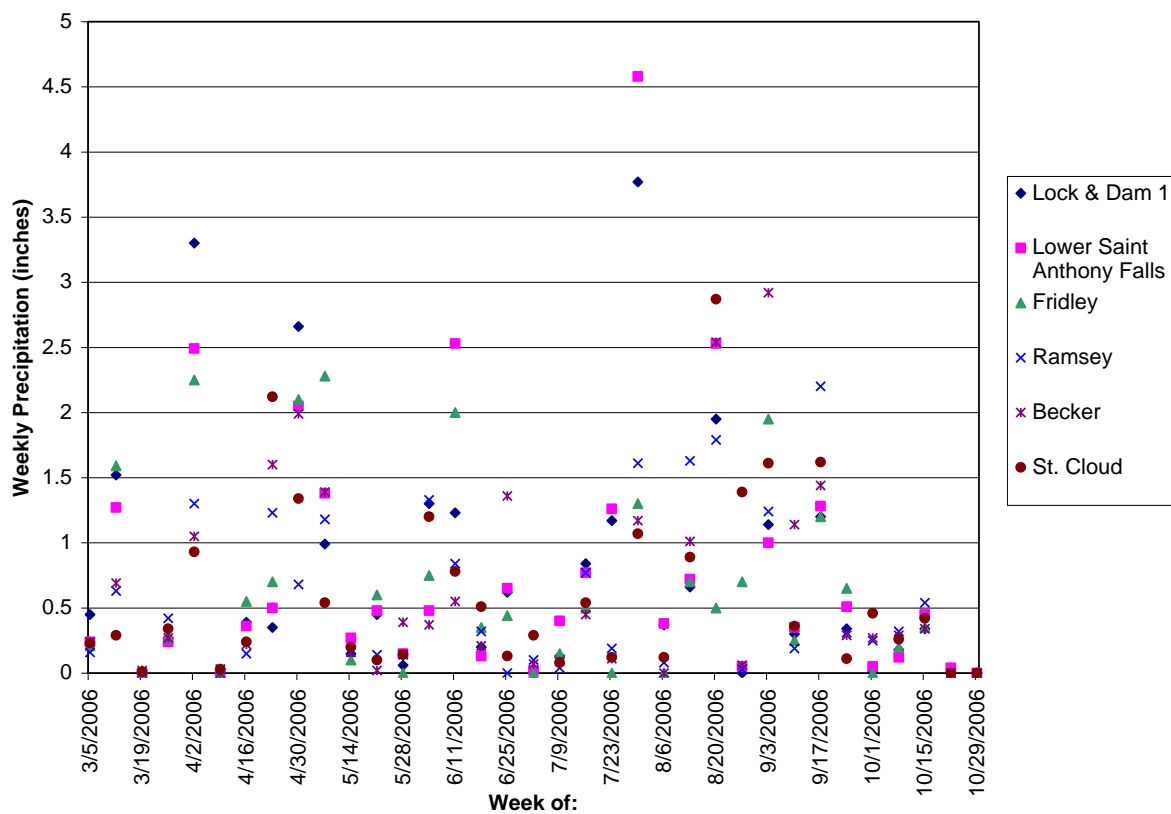


Figure 3. Precipitation for six locations along the Mississippi River.

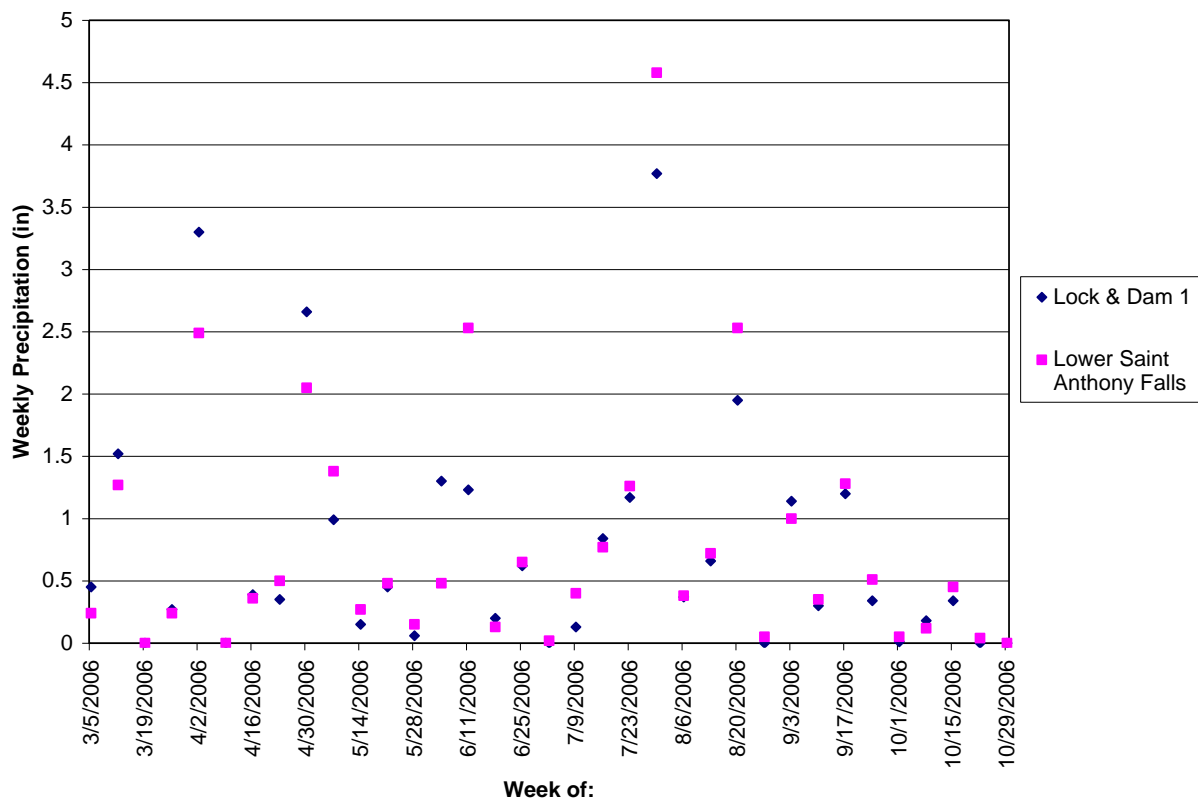


Figure 4. Precipitation for two locations in the MWMO watershed.

2007

Figure 5 shows precipitation for six locations along the Mississippi River: two in the watershed (Lower Saint Anthony Falls and Lock & Dam 1) and four between Saint Cloud and the MWMO northern boundary. Precipitation for the watershed only is shown in Figure 6. The MWMO acknowledges a link between precipitation and the water quality data shown in the following sections. However, the MWMO does not support quantitative analysis of this relationship because the precipitation data are not representative of the entire Mississippi River basin contributing to the MWMO watershed.

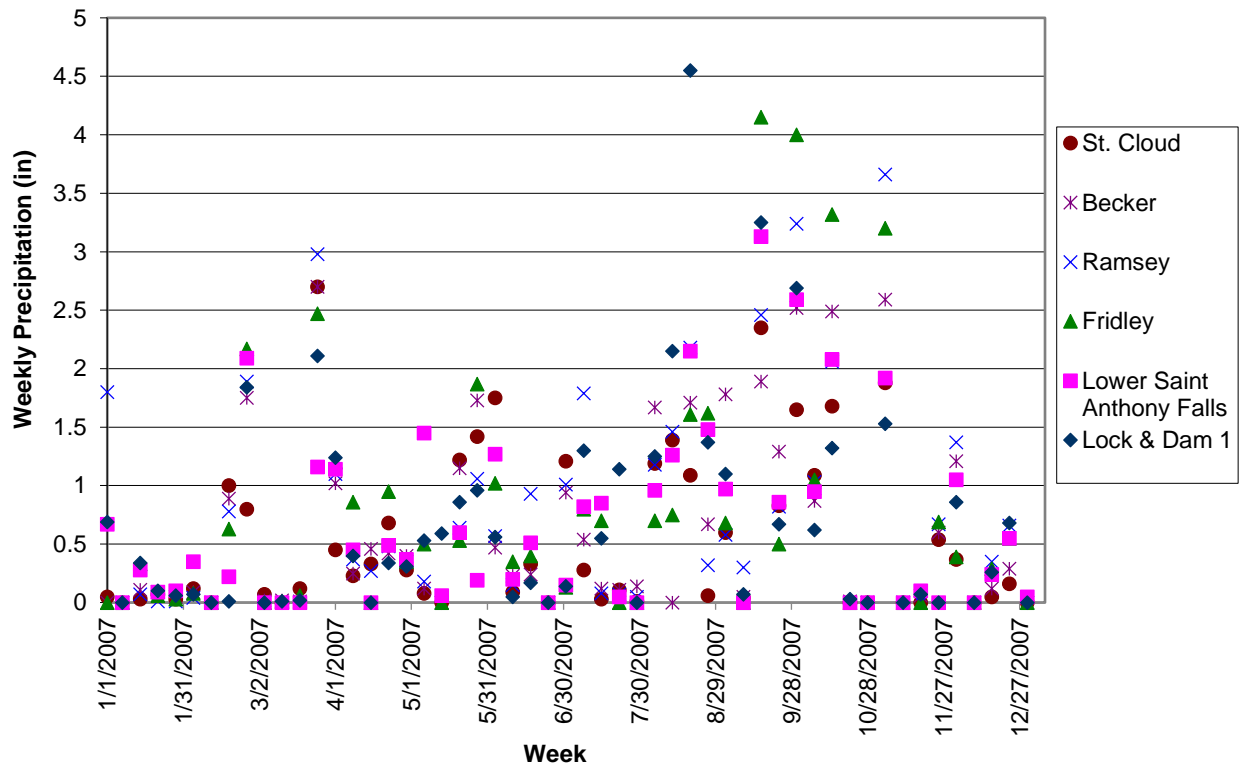


Figure 5. Precipitation for six locations along the Mississippi River.

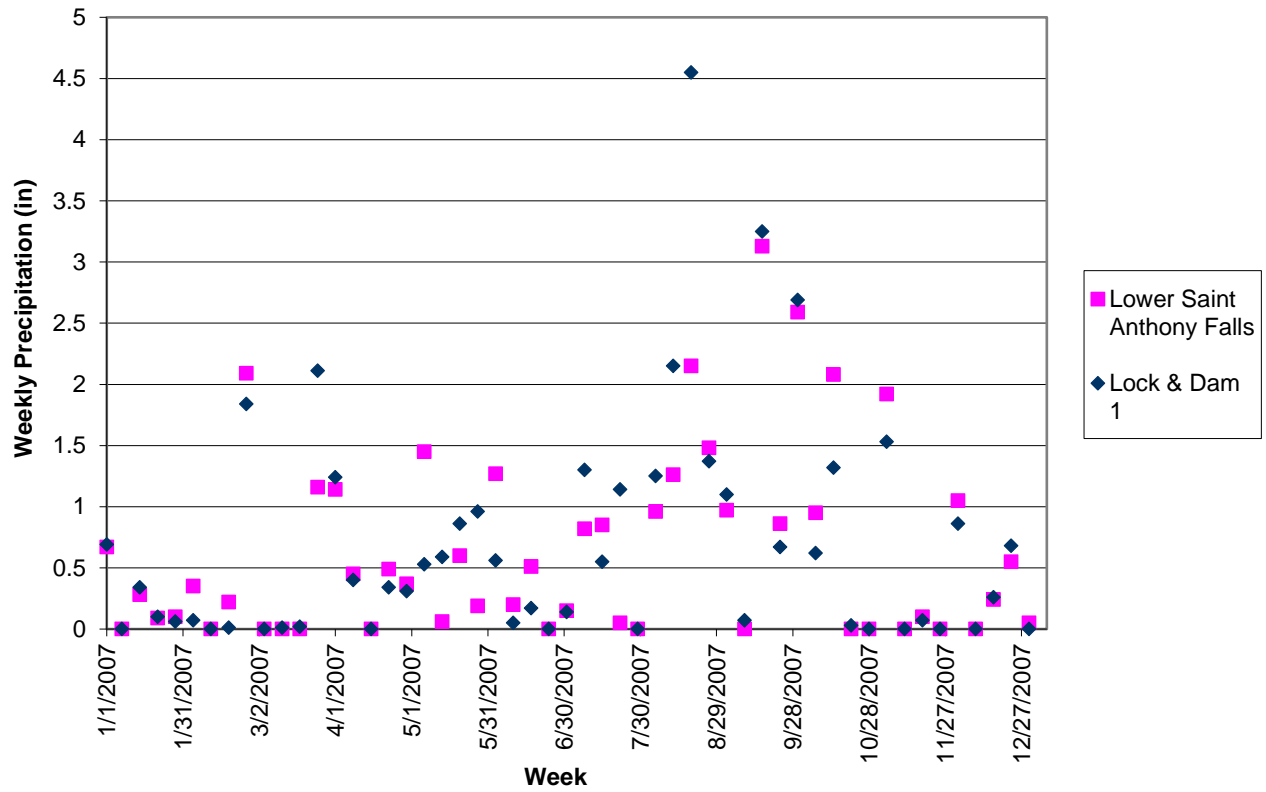


Figure 6. Precipitation for two locations in the MWMO watershed.

2008

Figure 7 shows precipitation for six locations along the Mississippi River: two in the watershed (Lower Saint Anthony Falls and Lock and Dam 1) and four between Saint Cloud and the MWMO northern boundary. Precipitation for the watershed only is shown in Figure 8. The MWMO acknowledges a link between precipitation and the water quality data shown in the following sections. However, the MWMO does not support quantitative analysis of this relationship because the precipitation data are not representative of the entire Mississippi River basin contributing to the MWMO watershed.

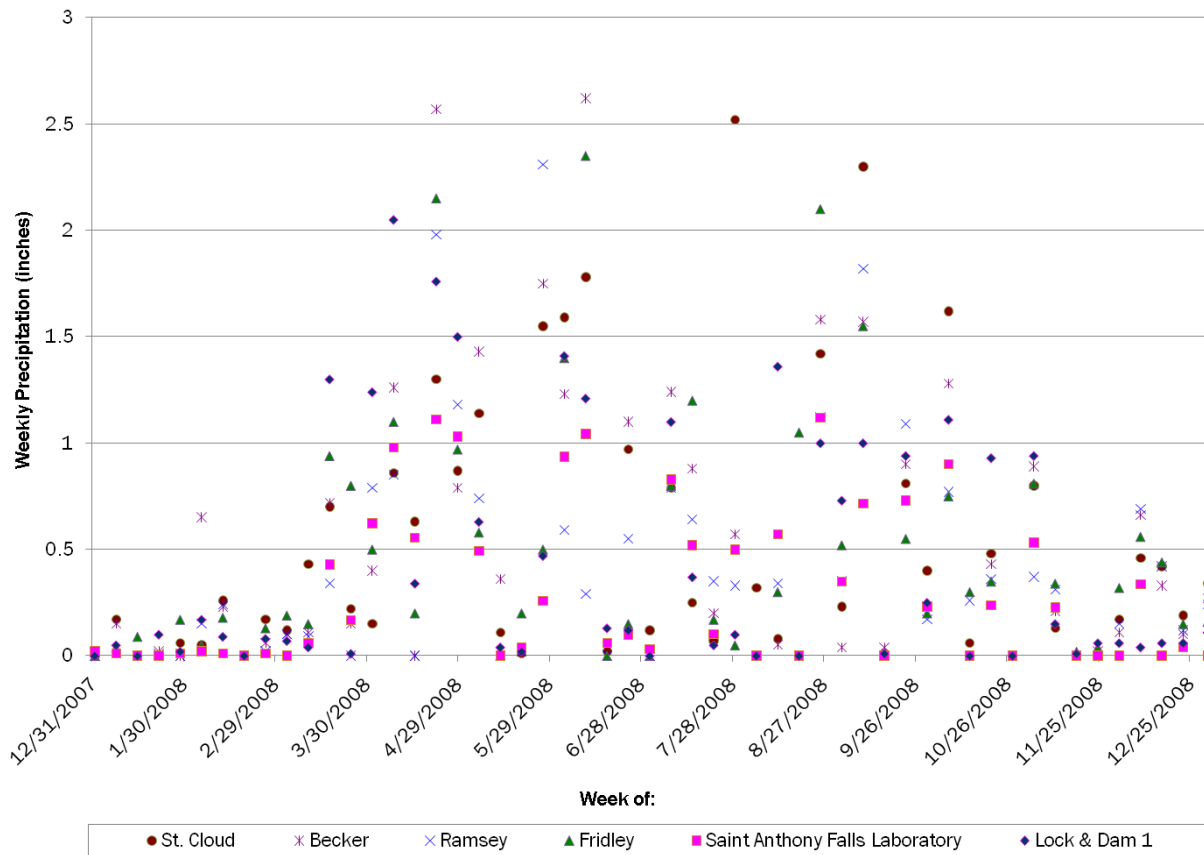


Figure 7. Precipitation for six locations along the Mississippi River.

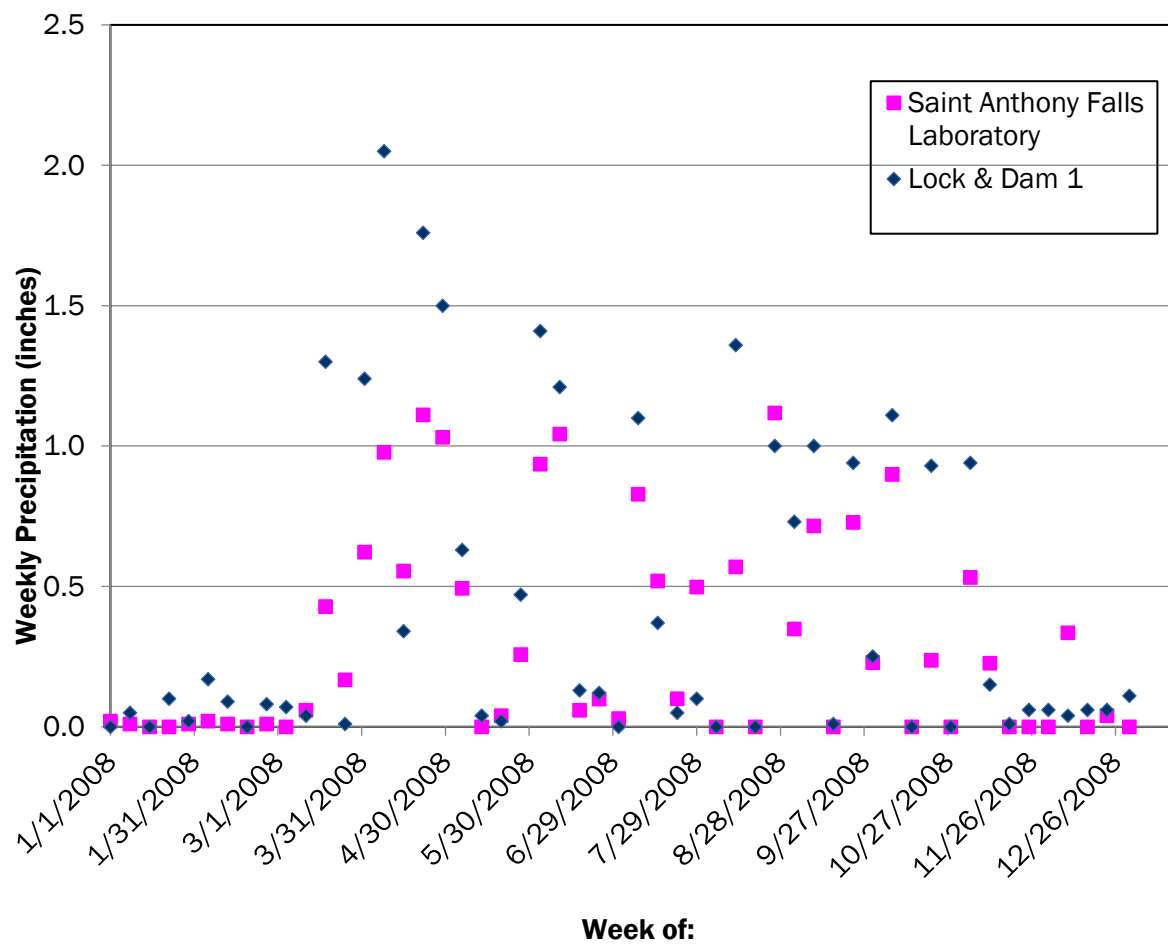


Figure 8. Precipitation for two locations in the MWMO watershed.

2009

Figure 9 shows precipitation for six locations along the Mississippi River: two in the watershed (Lower Saint Anthony Falls and Lock and Dam 1) and four between Saint Cloud and the MWMO northern boundary. Precipitation for the watershed only is shown in Figure 10. The MWMO acknowledges a link between precipitation and the water quality data shown in the following sections. However, the MWMO does not support quantitative analysis of this relationship because the precipitation data are not representative of the entire Mississippi River basin contributing to the MWMO watershed.

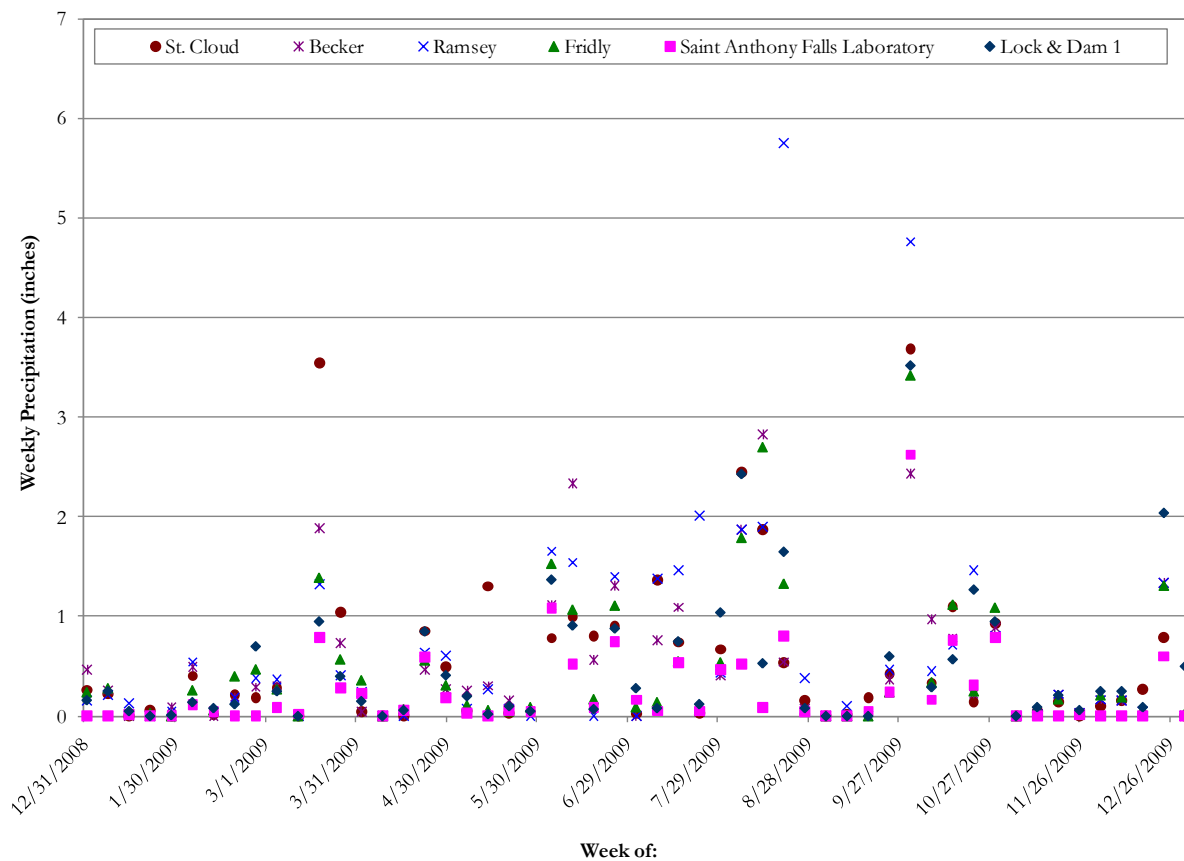


Figure 9. Precipitation for six locations along the Mississippi River.

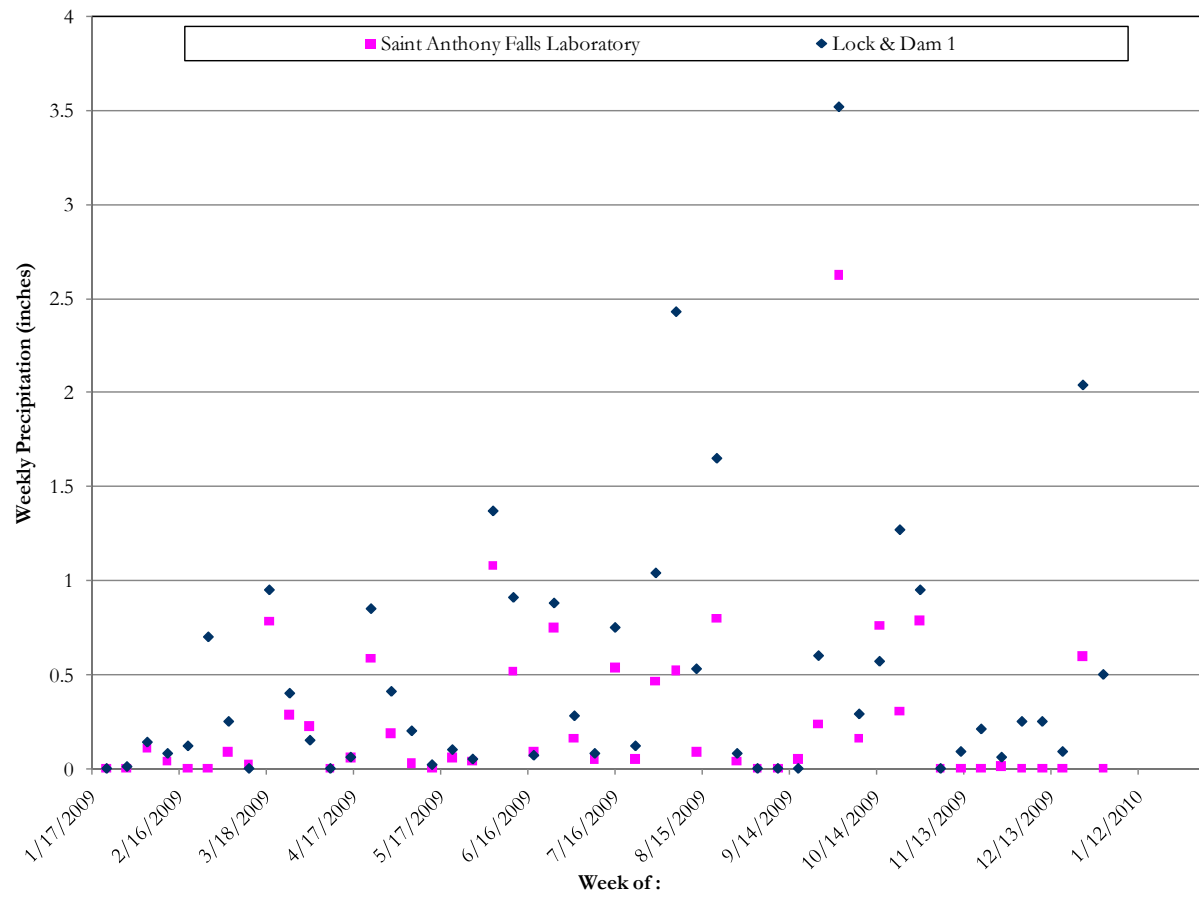


Figure 10. Precipitation for two locations in the MWMO watershed.

2010

Figure 11 shows precipitation for six locations along the Mississippi River: two in the watershed (Lower Saint Anthony Falls and Lock and Dam 1) and four between Saint Cloud and the MWMO northern boundary. Precipitation for the watershed only is shown in Figure 12. The MWMO acknowledges a link between precipitation and the water quality data shown in the following sections. However, the MWMO does not support quantitative analysis of this relationship because the precipitation data are not representative of the entire Mississippi River basin contributing to the MWMO watershed.

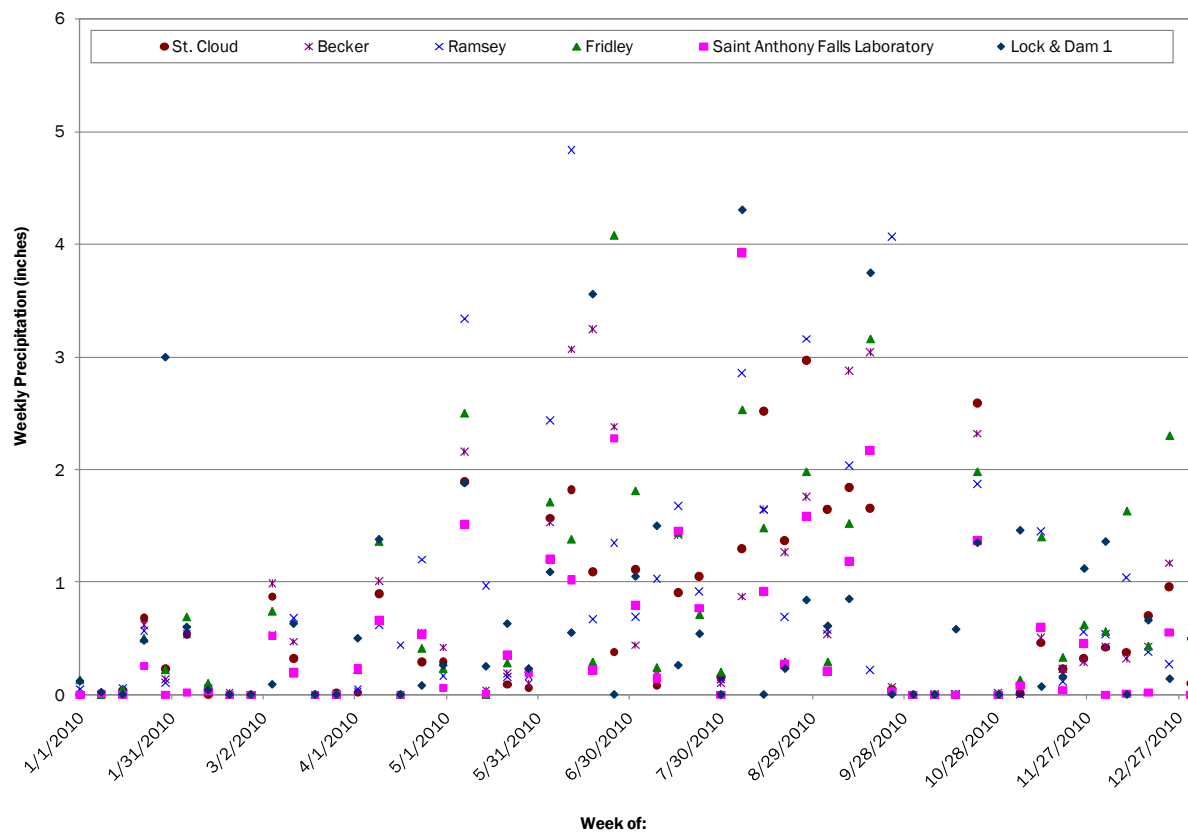


Figure 11. Precipitation for six locations along the Mississippi River.

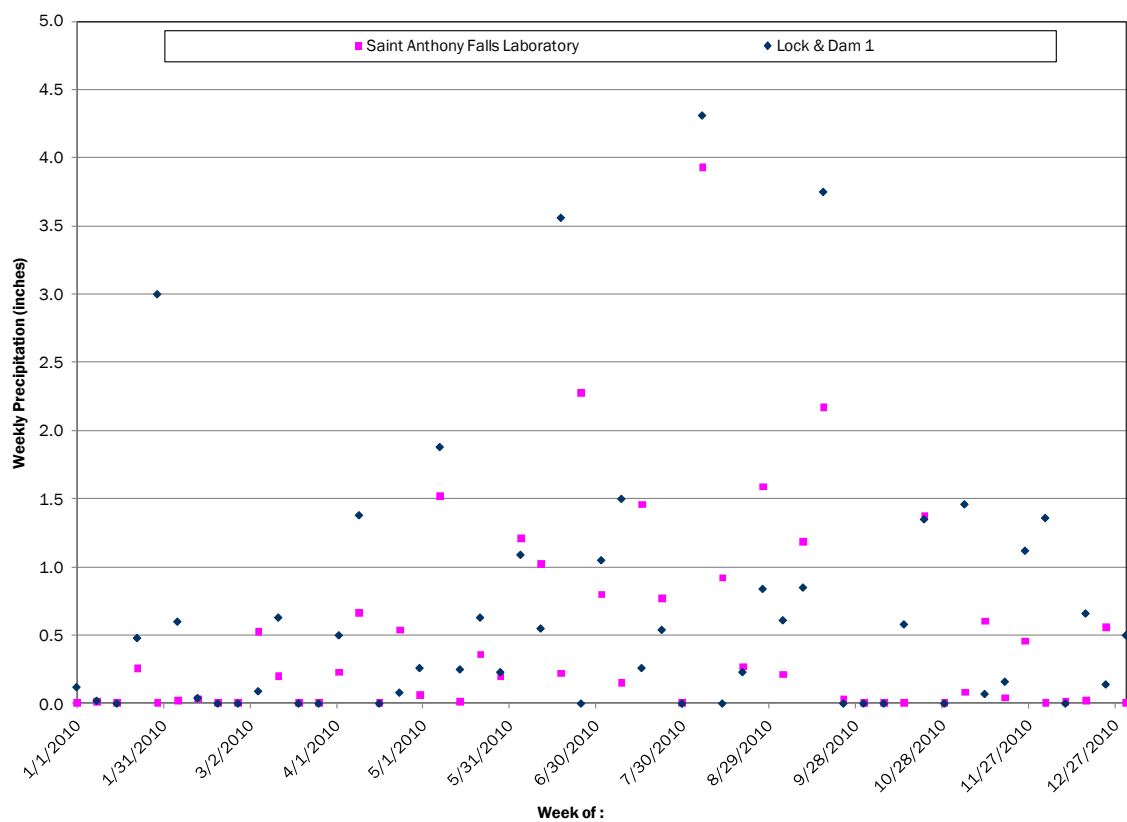


Figure 12. Precipitation for two locations in the MWMO watershed.

2011

Table 1 shows precipitation for several locations in the Upper Mississippi River basin between St. Cloud and the Minneapolis St. Paul International Airport. Precipitation at sites 1NE and 10SA were collected by the MWMO. Data at the Saint Anthony Falls Laboratory (SAFL) site were collected by SAFL. Precipitation at Lock and Dam 1 was measured by the United States Army Corps of Engineers. Precipitation data from all of the other sites were downloaded from the Minnesota Climatology Working Group website.

Table 1. Monthly precipitation at several locations in the Upper Mississippi River basin.

	St. Cloud ¹	Becker ²	New Hope ³	1NE ⁴	10SA ⁵	SAFL ⁶	Lock and Dam 1 ⁷	Chanhassen ⁸	Minneapolis St. Paul International Airport ⁹
January	0.97	0.93	1.04	0.00	0.51	0.01	0.91	0.98	1.00
February	0.88	0.93	0.86	0.09	0.06	0.15	1.65	1.14	1.12
March	2.02	1.92	2.26	1.35	1.69	1.47	2.37	2.32	2.06
April	2.15	3.60	3.67	4.39	3.01	2.61	2.81	3.02	2.80
May	5.51	5.62	6.26	3.83	3.96	2.91	5.15	4.78	4.04
June	2.87	3.09	4.16	3.83	3.90	4.11	4.63	3.98	5.28
July	5.63	9.67	6.36	8.04	8.60	6.95	6.96	5.38	5.23
August	5.32	3.23	4.54	3.38	4.31	3.60	3.87	4.27	3.03
September	0.74	0.61	0.31	0.09	0.22	0.36	0.50	0.26	0.36
October	1.43	0.79	0.78	0.42	0.62	0.52	0.93	0.78	0.70
November	0.23	0.14	0.22	0.09	0.20	0.08	0.15	0.16	0.30
December	0.40	0.12	0.44	0.36	0.51	0.49	0.79	0.91	0.99
Total	28.15	30.65	30.90	25.87	27.59	23.26	30.72	27.98	26.91

¹ Location: Latitude 45.54413 Longitude -94.07082, Source: <http://climate.umn.edu/hidradius/radius.asp>

² Location: Latitude 45.42064 Longitude -93.93335, Source: <http://climate.umn.edu/hidradius/radius.asp>

³ Location: Latitude 45.0167 Longitude -93.3667, Source: <http://climate.umn.edu/hidradius/radius.asp>

⁴ Location: Latitude 45.02389 Longitude -93.2772, Source: MWMO data

⁵ Location: Latitude 45.01278 Longitude -93.2203, Source: MWMO data

⁶ Location: Latitude 44.98239 Longitude -93.254932, Source: Personal communication with Chris Ellis, Saint Anthony Falls Laboratory

⁷ Location: Latitude 44.91497 Longitude -93.254932, Source: <http://www.mvp-wc.usace.army.mil/projects/Lock1.shtm>

⁸ Location: Latitude 44.8514 Longitude -93.5650, Source: <http://climate.umn.edu/hidradius/radius.asp>

⁹ Location: Latitude 44.88306 Longitude: -93.22889, Source: <http://climate.umn.edu/hidradius/radius.asp>

2012

Table 2 shows precipitation for several locations in the Upper Mississippi River Basin between St. Cloud and the Minneapolis St. Paul International Airport. Precipitation data at sites 1NE and 10SA were collected by the MWMO. In late 2012, the MWMO installed a heated rain gauge with a data logger at site 1NE to better monitor precipitation, including the water equivalent of snow. Precipitation data at the SAFL site were collected by SAFL. Precipitation at Lock and Dam 1 was measured by the USACE. Precipitation data from all of the other precipitation monitoring sites were downloaded from the Minnesota Climatology Working Group website.

Table 2. Monthly precipitation (inches) at several locations in the Upper Mississippi River basin.

	St. Cloud ¹	Becker ²	Elk River ³	New Hope ⁴	1NE ⁵	10SA ⁶	SAFL ⁷	Lock and Dam 1 ⁸	Chanhassen ⁹	Minneapolis St. Paul International Airport ¹⁰
January	0.57	0.93	0.55	0.32	0.04	0.35	0.13	0.81	0.34	0.36
February	1.24	1.06	1.44	2.21	0.58	0.62	1.14	0.77	2.42	1.71
March	1.15	1.19	1.37	1.26	1.36	1.70	1.12	1.52	1.22	1.40
April	2.60	1.78	2.05	2.72	2.08	2.53	2.06	3.37	3.20	3.04
May	8.76	11.27	11.96	9.17	7.98	7.68	6.91	9.70	11.23	9.34
June	2.36	4.32	3.52	3.62	3.05	2.74	2.54	3.92	4.73	3.59
July	3.59	4.03	4.20	4.53	3.95	4.26	3.92	5.16	3.34	4.90
August	1.22	1.24	0.90	1.64	1.43	1.31	0.69	1.26	2.30	1.38
September	0.24	0.21	0.42	0.50	0.33	0.60	0.29	0.27	0.44	0.30
October	0.73	0.68	0.10	1.52	1.32	1.29	1.27	1.42	1.16	1.30
November	1.05	0.96	0.82	0.93	0.32	0.60	0.63	0.81	0.77	0.63
December	1.52	1.58	1.35	1.79	0.36	1.22	0.66	1.91	1.65	1.64
Total	25.03	28.98	28.68	29.40	22.80	24.90	21.37	30.92	32.80	29.59

¹ Location: Latitude 45.54413 Longitude -94.07082, Source: <http://climate.umn.edu/hidradius/radius.asp>

² Location: Latitude 45.42064 Longitude -93.93335, Source: <http://climate.umn.edu/hidradius/radius.asp>

³ Location: Latitude 45.52726 Longitude -93.71100, Source: <http://climate.umn.edu/hidradius/radius.asp>

⁴ Location: Latitude 45.0167 Longitude -93.3667, Source: <http://climate.umn.edu/hidradius/radius.asp>

⁵ Location: Latitude 45.02389 Longitude -93.2772, Source: MWMO data

⁶ Location: Latitude 45.01278 Longitude -93.2203, Source: MWMO data

⁷ Location: Latitude 44.98239 Longitude -93.254932, Source: Personal communication with Chris Ellis, Saint Anthony Falls Laboratory

⁸ Location: Latitude 44.91497 Longitude -93.254932, Source: <http://www.mvp-wc.usace.army.mil/projects/Lock1.shtm>

⁹ Location: Latitude 44.8514 Longitude -93.5650, Source: <http://climate.umn.edu/hidradius/radius.asp>

¹⁰ Location: Latitude 44.88306 Longitude -93.22889, Source: <http://climate.umn.edu/hidradius/radius.asp>

2013

Tables 3 and 4 show precipitation for several locations in the Upper Mississippi River Basin between St. Cloud and the Minneapolis St. Paul International Airport. Precipitation data at sites 1NE, 10SA, Edison High School, Columbia Golf Course, 6th ST NE, and the MWMO Weather Station were collected by the MWMO. In 2013, the MWMO installed heated rain gauges with data loggers at the Edison High School (July), the Columbia Golf Course (September), and the MWMO Weather Station (May) sites to better monitor precipitation, including the water equivalent of snow. A Citizen Monitor gauge was set up in October at the 6th ST NE site, and the data are being collected and submitted to the MWMO by a volunteer. Precipitation data at the SAFL site were collected by SAFL. Precipitation at Lock and Dam 1 was measured by the USACE. Precipitation data from precipitation monitoring sites in St. Cloud, Becker, Elk River, and New Hope were downloaded from the Minnesota Climatology Working Group website and precipitation data from precipitation monitoring sites in Chanhassen and the Minneapolis St. Paul International Airport were downloaded from the Midwestern Regional Climate Center website.

Table 3. 2013 monthly precipitation (inches) at several locations in the Upper Mississippi River basin.

	St. Cloud¹	Becker²	Elk River³	New Hope⁴	SAFL⁵	Lock and Dam 1⁶	Chanhassen⁷	Minneapolis St. Paul International Airport⁸
January	0.45	0.56	0.48	0.70	0.62	0.95	0.66	0.86
February	1.33	1.23	1.09	1.29	0.33	0.59	1.05	1.33
March	2.63	2.31	1.54	2.24	1.06	0.53	1.64	2.04
April	2.90	2.99	3.80	5.46	3.29	5.93	5.60	5.22
May	4.98	2.17	2.79	4.55	4.66	4.93	6.55	6.24
June	5.76	4.39	5.43	8.49	5.45	6.33	6.28	5.17
July	1.43	2.39	4.22	3.48	2.39	0.50	4.69	3.51
August	0.85	1.05	0.47	1.65	1.37	2.01	1.74	2.07
September	1.87	2.79	2.78	1.27	0.84	1.20	1.57	1.35
October	4.34	3.64	3.10	4.53	3.31	3.63	3.53	3.00
November	0.53	0.63	0.98	0.59	0.41	0.70	0.51	0.52
December	1.77	1.45	1.01	1.66	0.30	0.00	1.26	1.46
Total	28.84	25.6	27.69	35.91	24.03	27.30	35.08	32.77

¹ Location: Latitude 45.54413 Longitude -94.07082, Source: <http://climate.umn.edu/hidradius/radius.asp>

² Location: Latitude 45.42064 Longitude -93.93335, Source: <http://climate.umn.edu/hidradius/radius.asp>

³ Location: Latitude 45.52726 Longitude -93.71100, Source: <http://climate.umn.edu/coop>

⁴ Location: Latitude 45.0167 Longitude -93.3667, Source: <http://climate.umn.edu/coop>

⁵ Location: Latitude 44.98239 Longitude -93.254932, Source: Personal communication with Chris Ellis, Saint Anthony Falls Laboratory SAFL

⁶ Location: Latitude 44.91497 Longitude -93.254932, Source: <http://www.mvp-wc.usace.army.mil/projects/Lock1.shtml>

⁷ Location: Latitude 44.8514 Longitude -93.5650, Source: <http://mrcc.isws.illinois.edu/climate>

⁸ Location: Latitude 44.88306 Longitude -93.22889, Source: <http://mrcc.isws.illinois.edu/climate>

Table 4. 2013 monthly precipitation (inches) at several locations in the MWMO precipitation monitoring network.

	1NE¹	10SA²	Edison High School³	Columbia Golf Course⁴	6th ST NE⁵	MWMO Weather Station⁶
January	0.66	0.60				
February	0.73	0.11				
March	1.69	1.48				
April	4.38	3.58				
May	4.01	5.40				
June	6.79	4.53				6.87
July	2.44	2.46				2.06
August	0.88	1.65	1.55			1.06
September	1.06	1.08	1.29			0.93
October	3.55	3.50	4.17	4.01	3.46	3.26
November	0.55	0.51	0.60	0.66	0.23	0.65
December	0.85	0.41	0.87	0.93	1.43	0.43
Total	27.69	25.31	8.64	6.40	5.12	15.50

¹ Location: Latitude 45.02389 Longitude -93.2772, Source: MWMO data, 1NE

² Location: Latitude 45.01278 Longitude -93.2203, Source: MWMO data, 10SA

³ Location: Latitude 45.012 Longitude -93.22, Source: MWMO Data, Edison High School

⁴ Location: Latitude 45.027 Longitude -93.255, Source: MWMO Data, Columbia Golf Course

⁵ Location: Latitude 45.053 Longitude -93.259, Source: Paul Vircks 4628 6th ST NE Minneapolis MN

⁶ Location: Latitude 45.013 Longitude -93.272, Source: MWMO Data, MWMO Weather Station

2014

Table 5 shows monthly precipitation data from the MWMO network of precipitation gauges, located primarily within the MWMO watershed. Precipitation data at sites 1NE, 10SA, 11CHF, Edison High School, Columbia Golf Course, Waite Park Elementary School, and the MWMO Weather Station were collected by the MWMO (Table 6). In May 2014, the MWMO installed a heated rain gauge with a data logger at the Waite Park Elementary School to complete its planned deployment of four heated rain gauges in and around the 1NE pipeshed. Precipitation data at site 6th ST NE were recorded and submitted by a MWMO citizen volunteer. Figure 13 shows 2014 monthly precipitation at the 1NE site in comparison to the 30-year monthly normal precipitation at Minneapolis St. Paul International Airport.

Table 5. 2014 monthly precipitation (inches) at several locations in the Upper Mississippi River basin.

	St. Cloud ¹	Becker ²	Elk River ³	New Hope ⁴	SAFL ⁵	Lock & Dam No. 1 ⁶	Chanhassen ⁷	Minneapolis St. Paul International Airport ⁸	MSP 30 YR MO Normal ⁹
January	1.34	1.21	0.99	1.47	0.10		1.32	1.42	0.90
February	1.17	1.24	1.58	1.45	0.10		1.59	1.41	0.77
March	1.20	1.01	0.87	0.89	0.15		0.70	0.82	1.89
April	5.90	7.06	6.65	7.79	4.83	4.18	7.07	6.27	2.66
May	6.74	7.42	6.28	4.79	3.40	4.48	6.81	4.55	3.36
June	6.18	6.64	9.09	8.38	7.47	11.78	8.90	11.36	4.25
July	1.25	3.48	2.02	4.07	2.46	2.05	3.26	2.27	4.04
August	5.59	5.03	3.06	2.31	2.50	3.14	2.88	2.90	4.30
September	4.06	2.35	2.52	1.89	1.73	1.99	1.41	0.92	3.08
October	0.65	0.75	0.74	1.08	1.02	2.02	0.79	1.75	2.43
November	1.89	2.54	1.55	1.30	0.20	0.37	0.73	0.87	1.77
December	0.75	0.89	1.18	1.14	0.56	0.45	0.97	0.86	1.16
Total	36.72	39.62	36.53	36.56	24.51	30.46	36.43	35.40	30.61

¹ Location: Latitude 45.54413 Longitude -94.07082, Source: http://www.dnr.state.mn.us/climate/historical/acis_stn_meta.html

² Location: Latitude 45.42064 Longitude -93.93335, Source: http://climate.umn.edu/hidradius/radius_new.asp

³ Location: Latitude 45.52726 Longitude -93.71100, Source: http://www.dnr.state.mn.us/climate/historical/acis_stn_meta.html

⁴ Location: Latitude 45.0167 Longitude -93.3667, Source: http://www.dnr.state.mn.us/climate/historical/acis_stn_meta.html

⁵ Location: Latitude 44.9823 Longitude -93.2549, Source: Personal communication with C Ellis, Saint Anthony Falls Laboratory (SAFL)

⁶ Location: Latitude 44.91497 Longitude -93.254932, Source: <http://www.mvp-wc.usace.army.mil/projects/Lock1.shtml>

⁷ Location: Latitude 44.8514 Longitude -93.5650, Source: http://www.dnr.state.mn.us/climate/historical/acis_stn_meta.html

⁸ Location: Latitude 44.88306 Longitude: -93.22889, Source: http://www.dnr.state.mn.us/climate/historical/acis_stn_meta.html

⁹ Location: Latitude 44.88306 Longitude: -93.22889, Source: http://www.ncdc.noaa.gov/cdo-web/search?datasetid=NORMAL_MLY

Table 6. 2014 monthly precipitation (inches) at several locations in the MWMO precipitation monitoring network.

	1NE ¹	10SA ²	11CHF ³	Edison High School ⁴	Columbia Golf Course ⁵	Waite Park Elementary School ⁶	6 th ST NE ⁷	MWMO Weather Station ⁸
January	0.51	0.29		0.49	0.69		0.81	0.14
February	0.80	0.30		0.88	1.07		0.80	0.12
March	0.61	1.00		0.72	0.65		0.65	0.45
April	6.30	5.23		6.75	6.70		5.69	4.41
May	3.85	3.69		4.27	4.24	2.64	3.71	2.88
June	8.01	7.16		8.70	5.83	8.26	7.01	8.67
July	2.67	2.78		2.89	3.50	3.50	2.16	0.98
August	3.08	1.61		3.31	3.66	3.89	2.74	2.67
September	1.48	1.47		1.85	1.62	1.54	1.13	1.77
October	0.98	1.00	0.87	1.18	1.17	1.16	0.88	1.15
November	0.79	0.44	0.23	0.72	0.65	0.77	1.10	0.22
December	0.50	0.67	0.43	0.57	0.67	0.62	0.88	0.48
Total	29.58	25.64	1.53	32.33	30.45	22.38	27.56	23.94

¹ Location: Latitude 45.02389 Longitude -93.2772, Source: MWMO data, 1NE

² Location: Latitude 45.01278 Longitude -93.2203, Source: MWMO data, 10SA

³ Location: Latitude 45.050 Longitude -93.274, Source: MWMO data, 11CHF

⁴ Location: Latitude 45.012 Longitude -93.22, Source: MWMO Data, Edison High School

⁵ Location: Latitude 45.027 Longitude -93.255, Source: MWMO Data, Columbia Golf Course

⁶ Location: Latitude 45.030 Longitude -93.234, Source: MWMO Data, Waite Park Elementary School

⁷ Location: Latitude 45.053 Longitude -93.259, Source: Citizen Volunteer, Minneapolis MN

⁸ Location: Latitude 45.013 Longitude -93.272, Source: MWMO Data, MWMO

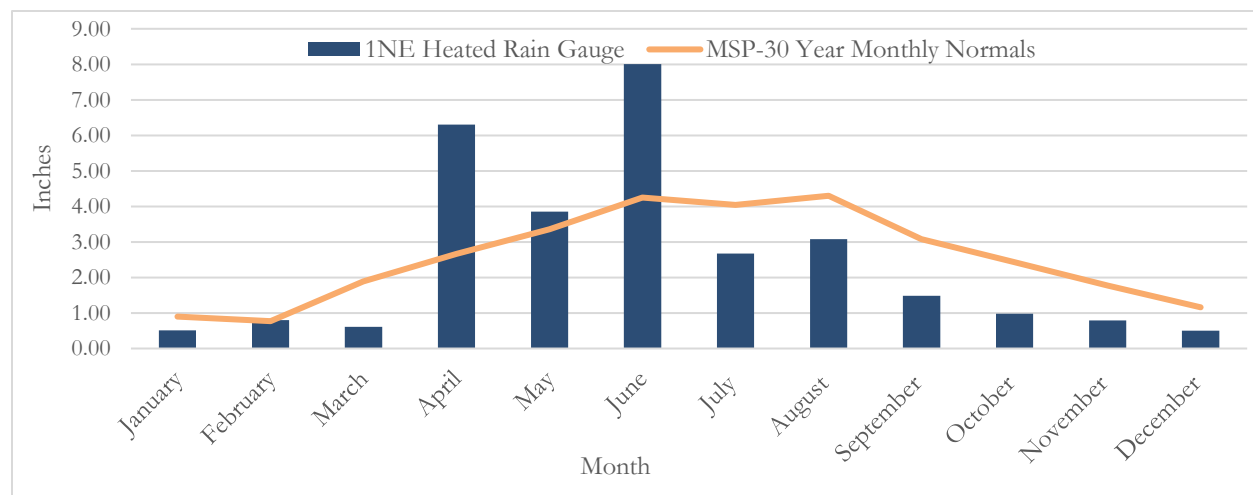


Figure 13. 2014 Monthly precipitation totals at the 1NE heated rain gauge compared to 30-year monthly precipitation normals at the Minneapolis St. Paul International Airport.

2015

Table 7 shows monthly precipitation data from the MWMO network of precipitation gauges, located primarily within the MWMO watershed. Precipitation data at sites 1NE, 10SA, 11CHF, Edison High School, Columbia Golf Course, Waite Park Elementary School, and the MWMO Weather Station were collected by the MWMO (Table 8). Precipitation data at site 6th ST NE were recorded and submitted by MWMO citizen volunteers. Figure 14 shows 2015 monthly precipitation at the 1NE site in comparison to the 30-year monthly precipitation normals at Minneapolis St. Paul International Airport.

Table 7. 2015 monthly precipitation (inches) at several locations in the Upper Mississippi River basin.

	St. Cloud ¹	Becker ²	Elk River ³	New Hope ⁴	SAFL ⁵	Lock & Dam No. 1 ⁶	Chanhassen ⁷	Minneapolis St. Paul International Airport ⁸	MSP 30 YR MO Normal ⁹
January	0.24	0.15	0.09	0.34	0.02	0.17	0.37	0.34	0.90
February	0.35	0.31	0.48	0.38	0.00	0.13	0.39	0.35	0.77
March	0.38	0.34	0.51	0.80	0.38	0.54	0.78	0.67	1.89
April	1.67	1.05	0.69	1.81	1.82	2.35	2.22	2.42	2.66
May	6.03	5.85	3.48	4.46	3.54	3.70	4.96	3.55	3.36
June	4.66	4.43	3.02	3.37	2.78		3.66	4.40	4.25
July	7.18	6.02	3.82	8.30	5.71		7.89	7.32	4.04
August	3.10	8.74	4.63	2.98	2.18		2.71	2.99	4.30
September	2.24	2.12	1.11	3.79	2.91		3.19	4.65	3.08
October	3.14	3.81	4.47	2.93	2.45		2.54	2.61	2.43
November	3.10	2.71	2.23	4.56	3.28		4.73	4.52	1.77
December	1.02	1.99	1.20	1.65	1.61	0.99	1.97	2.32	1.16
Total	33.11	37.52	25.73	35.37	26.67	7.88	35.41	36.14	30.61

¹ Location: Latitude 45.5441 Longitude -94.0708, Source: http://www.dnr.state.mn.us/climate/historical/acis_stn_meta.html

² Location: Latitude 45.4206 Longitude -93.9333, Source: http://climate.umn.edu/hidradius/radius_new.asp

³ Location: Latitude 45.5272 Longitude -93.7110, Source: http://www.dnr.state.mn.us/climate/historical/acis_stn_meta.html

⁴ Location: Latitude 45.0167 Longitude -93.3667, Source: http://www.dnr.state.mn.us/climate/historical/acis_stn_meta.html

⁵ Location: Latitude 44.9823 Longitude -93.2549, Source: C Ellis, Saint Anthony Falls Laboratory (SAFL)

⁶ Location: Latitude 44.9149 Longitude -93.2549, Source: <http://www.mvp-wc.usace.army.mil/projects/Lock1.shtml>

⁷ Location: Latitude 44.8514 Longitude -93.5650, Source: http://www.dnr.state.mn.us/climate/historical/acis_stn_meta.html

⁸ Location: Latitude 44.8830 Longitude: -93.2288, Source: http://www.dnr.state.mn.us/climate/historical/acis_stn_meta.html

⁹ Location: Latitude 44.8830 Longitude: -93.2288, Source: http://www.ncdc.noaa.gov/cdo-web/datasets/NORMAL_MLY/stations/GHCND:USW00014922/detail

Table 8. 2015 monthly precipitation (inches) at several locations in the MWMO precipitation monitoring network.

	1NE ¹	10SA ²	11CHF ³	Edison High School ⁴	Columbia Golf Course ⁵	Waite Park Elementary School ⁶	6 th ST NE ⁷	MWMO Weather Station ⁸
January	0.06	0.11	0.03	0.05	0.09	0.05	0.12	0.04
February	0.00	0.00	0.00		0.81		0.17	0.28
March	0.33	0.53	0.36		1.86		0.51	0.78
April	1.71	1.82	1.56		3.46		1.91	
May	3.53	4.24	3.89				3.79	3.14
June	2.75	3.19	3.68				3.78	2.85
July	4.86	4.98	4.94	6.61	2.49	6.82	5.84	5.53
August	2.31	2.50	2.84	2.76	3.08	2.96	3.10	2.07
September	3.27	3.17	3.02	4.41	4.13	4.18	3.27	3.72
October	2.11	2.51	2.25	2.84	2.30	2.59	2.44	2.21
November	3.05	3.67	3.17	4.32	4.32	4.45	3.43	3.99
December	1.48	1.74	1.25	1.56	1.72	1.63	1.97	1.35
Total	25.4	28.46	26.96	22.55	24.26	22.68	30.33	25.96

¹ Location: Latitude 45.023 Longitude -93.277, Source: MWMO data, 1NE

² Location: Latitude 45.012 Longitude -93.220, Source: MWMO data, 10SA

³ Location: Latitude 45.050 Longitude -93.274, Source: MWMO data, 11CHF

⁴ Location: Latitude 45.012 Longitude -93.22, Source: MWMO Data, Edison High School

⁵ Location: Latitude 45.027 Longitude -93.255, Source: MWMO Data, Columbia Golf Course

⁶ Location: Latitude 45.030 Longitude -93.234, Source: MWMO Data, Waite Park Elementary School

⁷ Location: Latitude 45.053 Longitude -93.259, Source: Citizen Volunteer, Minneapolis MN

⁸ Location: Latitude 45.013 Longitude -93.272, Source: MWMO Data, MWMO Weather Station

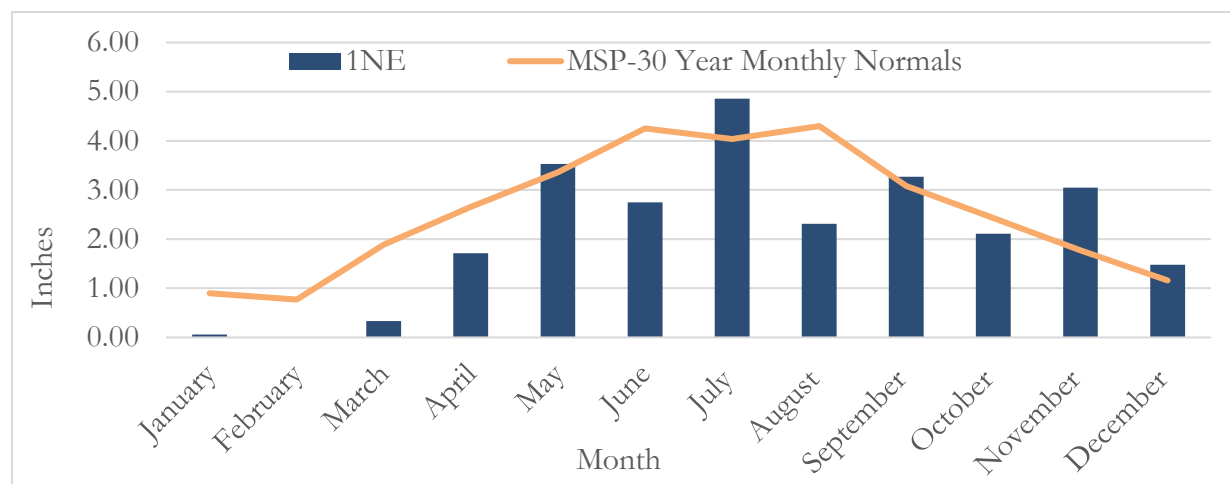


Figure 14. 2015 monthly precipitation totals at the 1NE heated rain gauge compared to 30-year monthly precipitation normals at the Minneapolis St. Paul International Airport.

2016

Table 9 shows monthly precipitation data from the MWMO network of precipitation gauges, located primarily within the MWMO watershed. Precipitation data at sites 1NE, 10SA, 11CHF, Edison High School, Columbia Golf Course, Waite Park Elementary School, and the MWMO Weather Station were collected by MWMO staff (Table 10). Precipitation data at the 6th Street NE site were recorded and submitted by MWMO citizen volunteers. Figure 15 shows 2016 monthly precipitation at the 1NE site in comparison to the 30-year monthly precipitation normals at Minneapolis-St. Paul International Airport.

Table 9. 2016 monthly precipitation (inches) at several locations in the Upper Mississippi River basin.

Month	St. Cloud ¹	Becker ²	Elk River ³	New Hope ⁴	SAFL ⁵	Chanhassen ⁷	Minneapolis St. Paul International Airport ⁸	MSP 30 YR MO Normal ⁹
January	0.31	0.56	0.27	0.31	0.17	0.31	0.31	0.90
February	0.63	1.07	0.54	1.02	0.23	1.18	1.09	0.77
March	1.50	1.15	1.90	1.92	1.59	1.42	2.26	1.89
April	1.74	2.67	2.76	3.73	3.45	3.31	2.84	2.66
May	2.17	3.97	3.11	2.13	1.36	2.03	2.42	3.36
June	3.37	3.18	2.61	3.47	3.60	4.58	4.49	4.25
July	6.74	7.57	7.34	5.74	3.76	5.43	5.09	4.04
August	8.36	5.46	7.11	9.15	8.00	9.70	7.82	4.30
September	3.08	5.30	4.44	7.08	3.90	5.15	5.47	3.08
October	2.68	2.11	2.70	3.25	2.31	3.46	3.41	2.43
November	1.69	1.47	2.13	2.92	2.02	1.71	2.98	1.77
December	1.58	1.43	0.16	1.26	1.23	2.25	2.14	1.16
Total	33.85	35.94	35.07	41.98	31.62	40.53	40.32	30.61

¹ Location: Latitude 45.5441 Longitude -94.0708, Source: http://www.dnr.state.mn.us/climate/historical/acis_stn_meta.html

² Location: Latitude 45.4206 Longitude -93.9333, Source: http://climate.umn.edu/hidradius/radius_new.asp

³ Location: Latitude 45.5272 Longitude -93.7110, Source: http://www.dnr.state.mn.us/climate/historical/acis_stn_meta.html

⁴ Location: Latitude 45.0167 Longitude -93.3667, Source: http://www.dnr.state.mn.us/climate/historical/acis_stn_meta.html

⁵ Location: Latitude 44.9823 Longitude -93.2549, Source: C Ellis, Saint Anthony Falls Laboratory (SAFL)

⁶ Location: Latitude 44.9149 Longitude -93.2549, Source: <http://www.mvp-wc.usace.army.mil/projects/Lock1.shtml>

⁷ Location: Latitude 44.8514 Longitude -93.5650, Source: http://www.dnr.state.mn.us/climate/historical/acis_stn_meta.html

⁸ Location: Latitude 44.8830 Longitude: -93.2288, Source: http://www.dnr.state.mn.us/climate/historical/acis_stn_meta.html

⁹ Location: Latitude 44.8830 Longitude: -93.2288, Source: http://www.ncdc.noaa.gov/cdo-web/datasets/NORMAL_MLY/stations/GHCND:USW00014922/detail

Table 10. 2016 monthly precipitation (inches) at several locations in the MWMO precipitation monitoring network.

Month	1NE ¹	10SA ²	11CHF ³	Edison High School ⁴	Columbia Golf Course ⁵	Waite Park Elementary School ⁶	6 th ST NE ⁷	MWMO Weather Station ⁸
January	0.20	0.26	0.10	0.20	0.12	0.13	0.33	0.10
February	0.48	0.37	0.14	0.32	0.39	0.50	0.90	0.24
March	1.59	1.69	1.51	0.93	1.75	1.76	1.13	1.83
April	3.47	3.35	3.08	3.97	2.32	3.78	3.43	3.32
May	2.11	1.68	2.06	2.33	2.63	2.34	2.18	1.79
June	2.42		2.69	3.46	2.54	2.92	2.72	2.84
July	5.14		4.84	6.84	6.58	3.71	5.77	5.47
August	7.35		7.12	8.54	8.08	8.63	7.32	7.44
September	4.97		5.05	6.23	5.91	5.88	5.26	5.19
October	2.81	3.35	2.49	3.01	3.28	2.89	2.77	2.60
November	2.38	2.42	2.18	2.59	2.87	2.50	2.59	2.26
December	1.49	1.25	1.15	1.41	1.42	1.61	2.11	1.96
Total	34.41	NA	32.41	39.83	37.89	36.65	36.51	35.05

1 Location: Latitude 45.023 Longitude -93.277, Source: MWMO data, 1NE

2 Location: Latitude 45.012 Longitude -93.220, Source: MWMO data, 10SA

3 Location: Latitude 45.050 Longitude -93.274, Source: MWMO data, 11CHF

4 Location: Latitude 45.012 Longitude -93.22, Source: MWMO Data, Edison High School

5 Location: Latitude 45.027 Longitude -93.255, Source: MWMO Data, Columbia Golf Course

6 Location: Latitude 45.030 Longitude -93.234, Source: MWMO Data, Waite Park Elementary School

7 Location: Latitude 45.053 Longitude -93.259, Source: Citizen Volunteer, Minneapolis MN

8 Location: Latitude 45.013 Longitude -93.272, Source: MWMO Data, MWMO Weather Station

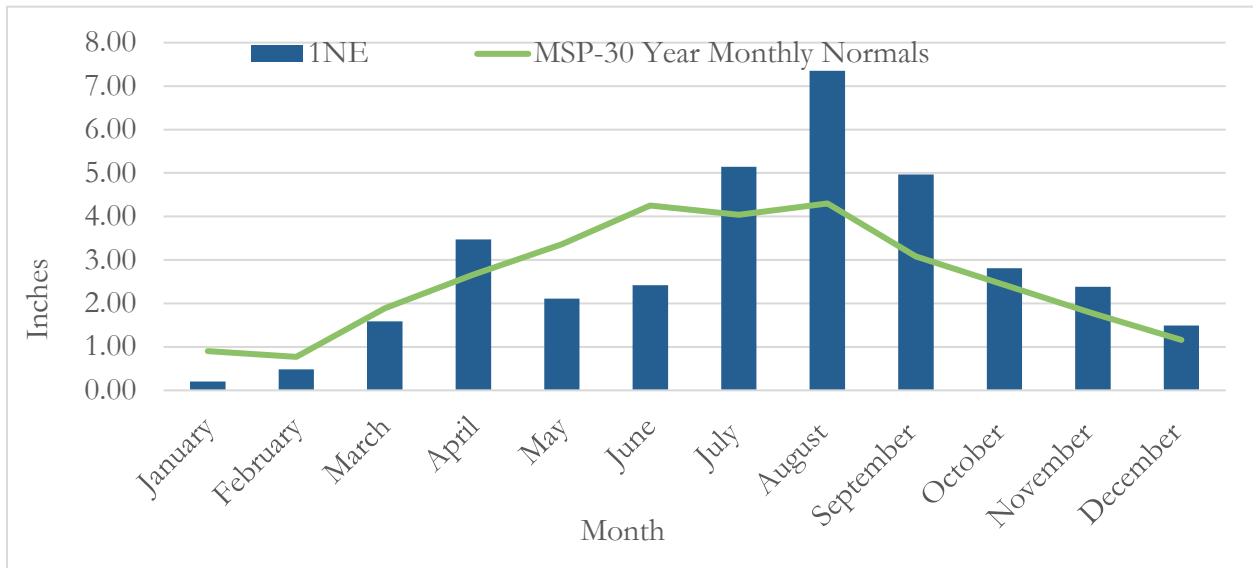


Figure 15. 2016 monthly precipitation totals at the 1NE heated rain gauge compared to 30-year monthly precipitation normals at the Minneapolis-St. Paul International Airport.

Appendix A

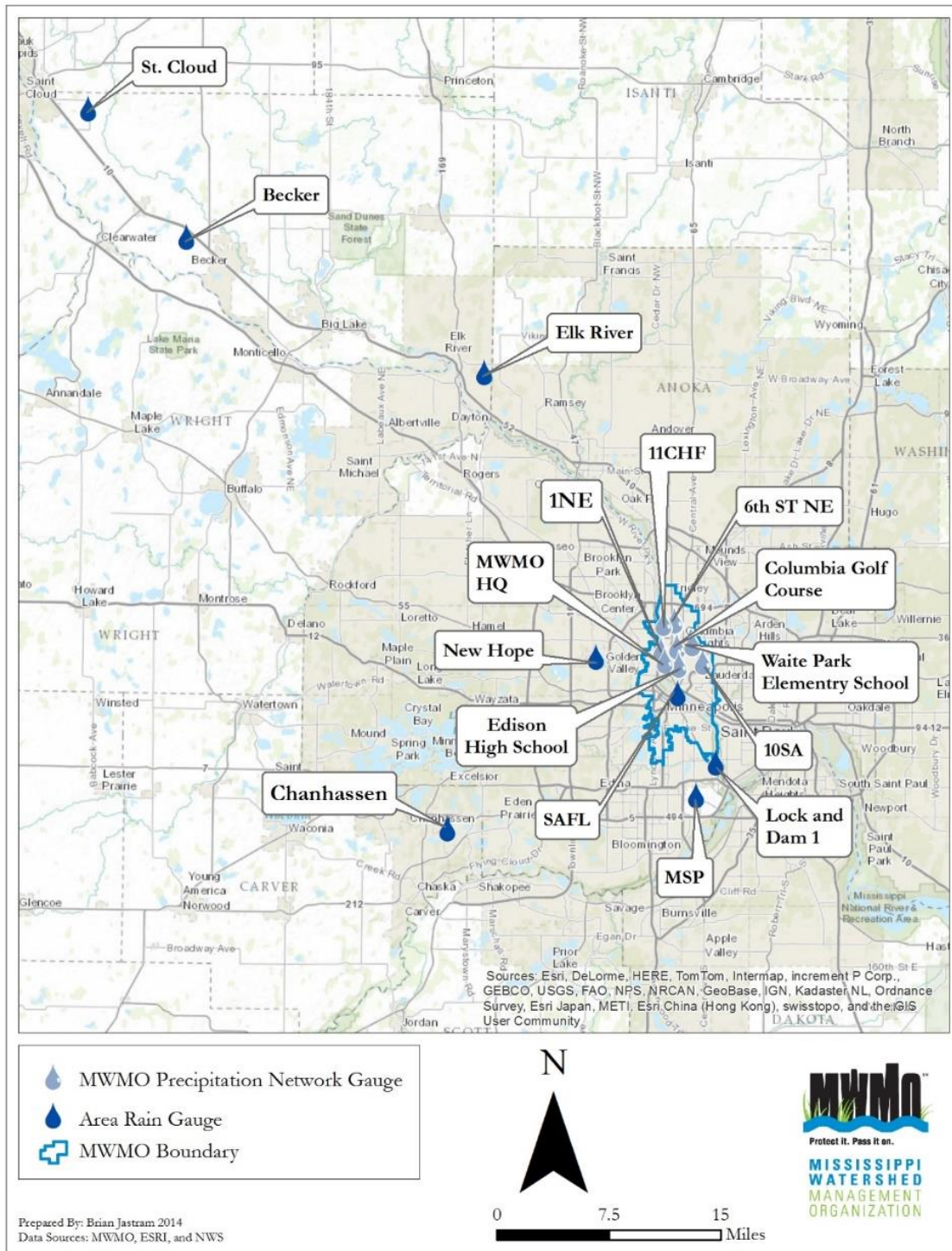


Figure A.1. Precipitation gauges in the Upper Mississippi River Basin.