

2019 Annual Rainfall Report

Monitoring and Modeling



Saskatoon Water
Utilities and Environment Department



EXECUTIVE SUMMARY

The following report provides a summary of Saskatoon's 2019 rainfall season (April to September) and a comparison with historical rainfall. Highlights of the report include the following:

- In 2019, 258 mm of rainfall accumulated, which was slightly less than the historical average of 264 mm.
- On average, rainfall occurred on 35% of days in 2019.
- Based on the weighted average, 37 mm was the largest amount of rainfall to accumulate in a single day.
- Saskatoon had a moderately dry spring in 2019. The average rainfall between April and June since 1900 is 127 mm. Saskatoon received 103 mm which falls in the 39th percentile for this time period.
- Saskatoon had a moderately wet summer in 2019. The average rainfall between July and September since 1900 is 137 mm. Saskatoon received 155 mm which falls in the 64th percentile for this time period.
- 2019 had an average of three rain events with a return period of two years or greater.
- A 5-25 year rain event occurred in the morning of July 14th, 2019 and a 2-5 year rain event occurred in the evening of the same day.



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INTRODUCTION

The purpose of this report is to provide a summary of the 2019 rainfall season in Saskatoon and a comparison of this rainfall data with historical rainfall data. Within the scope of this report, a rainfall season is defined as the time period between April 1st and September 30th. Data between 1900 and 2011 was obtained from the Environment Canada rain gauge while 2012 to 2016 data was obtained from eight City of Saskatoon rain gauges. In 2017, one of the City of Saskatoon rain gauges was decommissioned and therefore seven rain gauges remain. The name, location, approximate area, and total seasonal rainfall of each rain gauge is shown below.

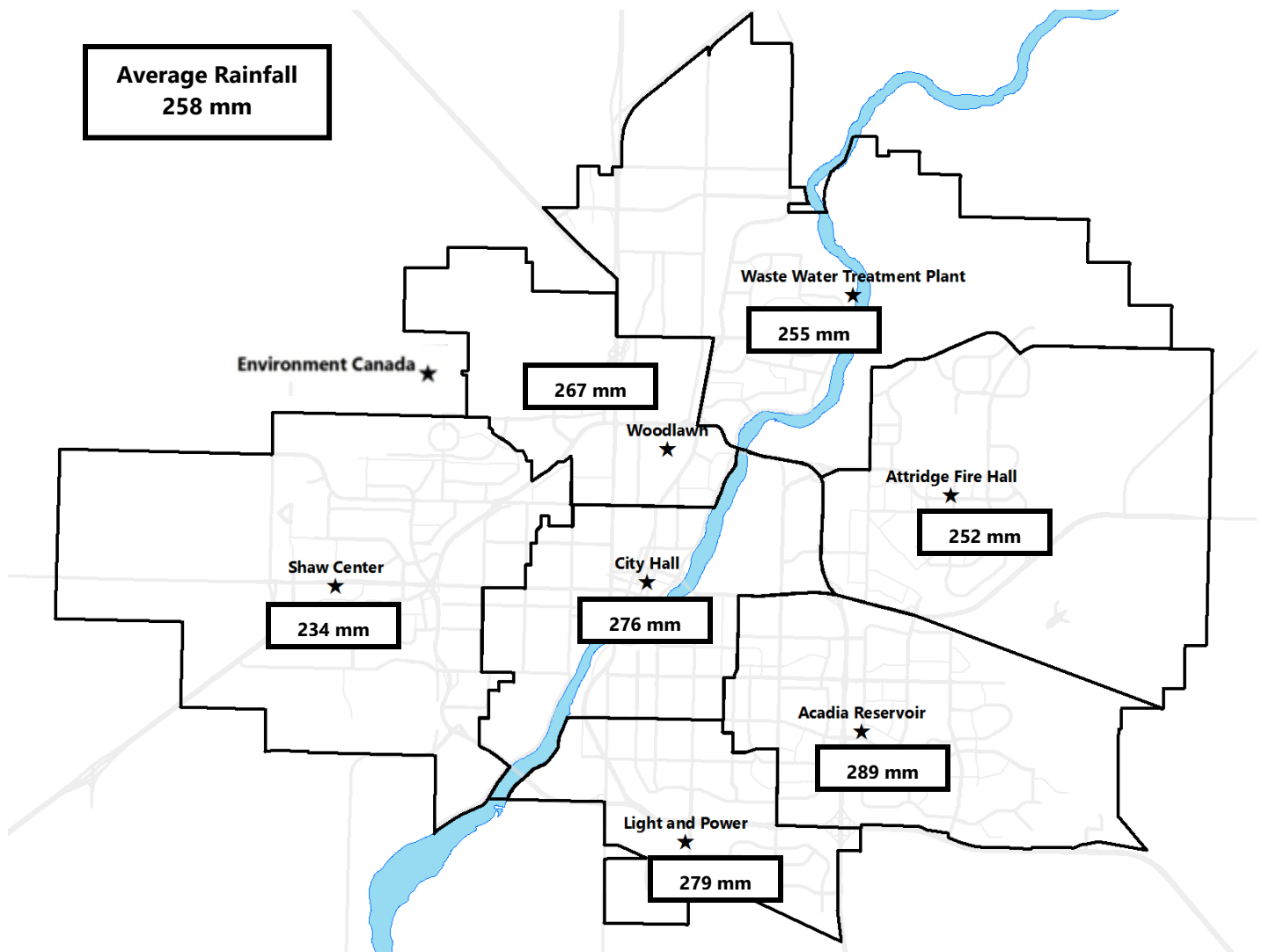


Figure 1: Overview of rain gauges.



SUMMARY OF RAINFALL IN 2019

A daily weighted average for all City of Saskatoon rain gauges functioning on a particular day was calculated to determine the average daily rainfall for Saskatoon. The following graph depicts the average daily rainfall that occurred in Saskatoon throughout the 2019 rainfall season.

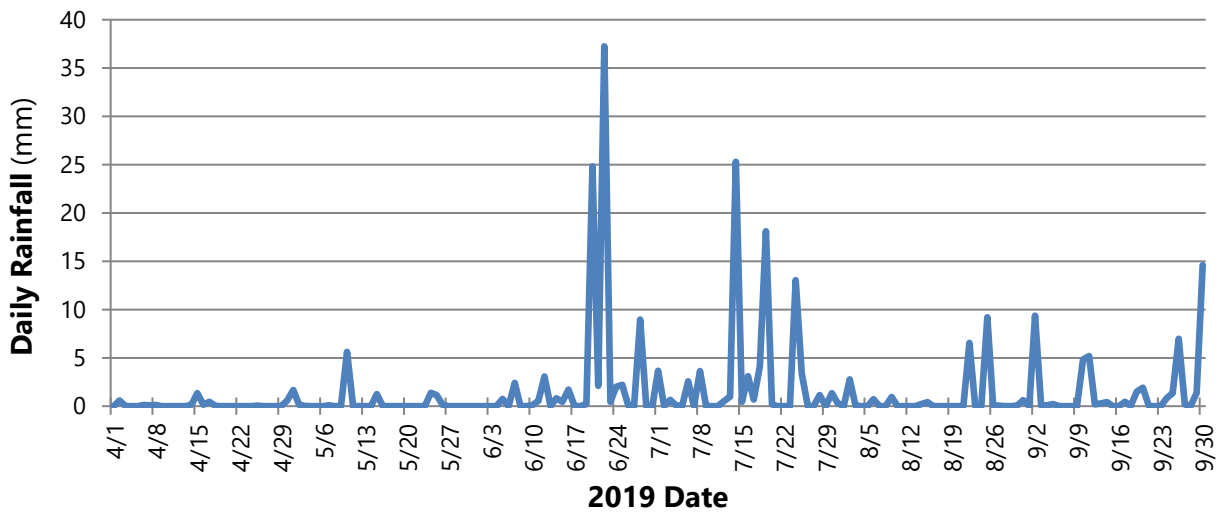


Figure 2: 2019 daily rainfall.

Based on the weighted average, the largest amount of rainfall occurred on June 22nd, 2019 with a total of 37 mm. This rainfall accounted for approximately 14% of the total rainfall that occurred in 2019.

Table 1 presents the percentage of days with total rainfall greater than or equal to 0.2 mm, 1 mm, 5 mm, 10 mm, and 25 mm at each rain gauge.

Table 1: Total daily rainfall percent occurrence.

Location	≥ 0.2 mm	≥ 1 mm	≥ 5 mm	≥ 10 mm	≥ 25 mm
Acadia Reservoir	32%	19%	7%	4%	1%
Attridge Fire Hall	38%	21%	7%	4%	1%
City Hall	32%	20%	8%	4%	2%
Light and Power	34%	22%	7%	3%	2%
Shaw Center	38%	21%	6%	3%	1%
WWTP	37%	22%	8%	3%	1%
Woodlawn	34%	20%	7%	4%	1%
Average	35%	21%	7%	4%	1%

On average, rainfall occurred on 35% of days in 2019.



SUMMARY OF RAINFALL IN 2019

The total seasonal rainfall for 2019 was 258 mm. Figure 3 depicts the accumulation of rainfall throughout the 2019 season.

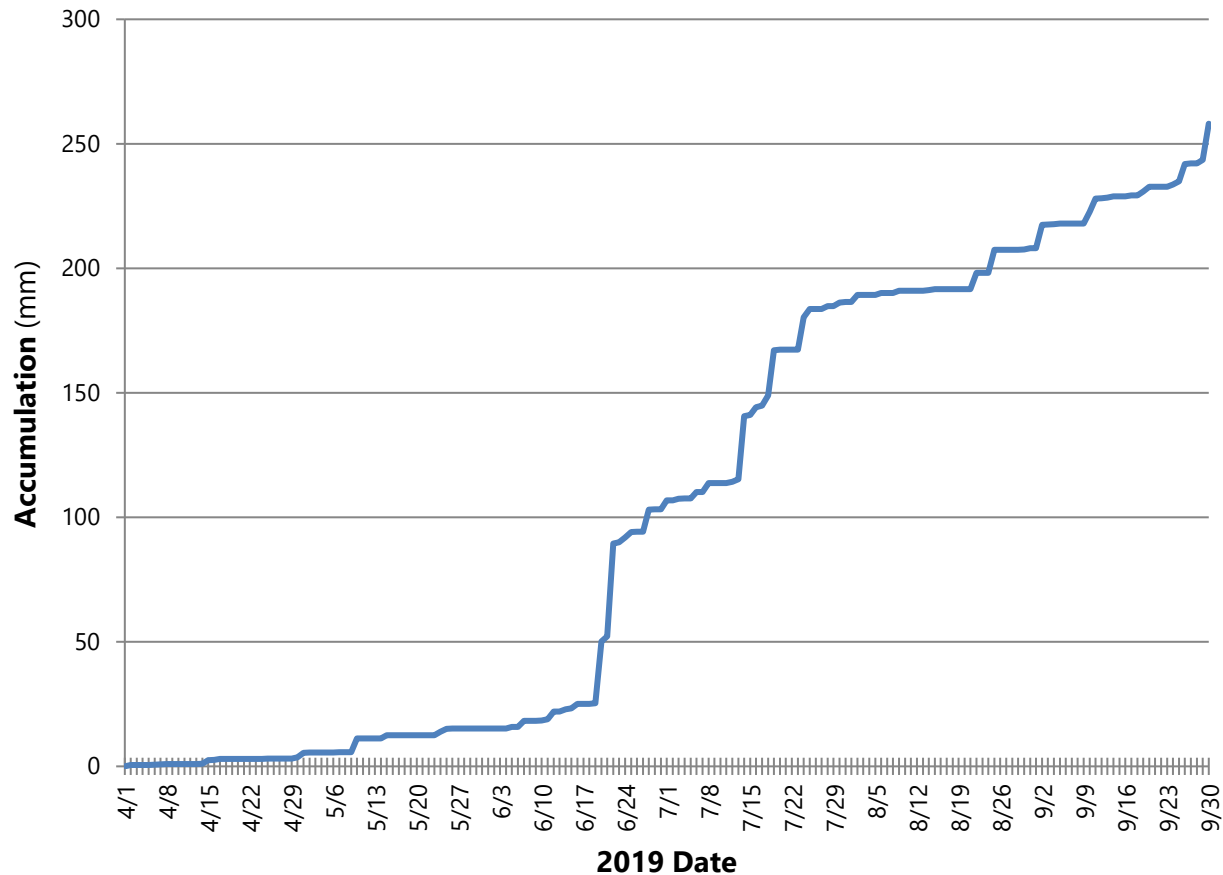


Figure 3: 2019 rainfall accumulation.

The 2019 rainfall season experienced a moderately dry spring, with the months of April to June accumulating a total of 103 mm of rain, which is the 47th lowest spring rainfall out of 120 years since 1900. This rainfall accounted for approximately 40% of the total rainfall that occurred throughout the season. The remaining 60% of the total rainfall occurred between July and September, accumulating a total of 155 mm of rain. This is the 42nd highest summer rainfall out of 120 years since 1900.



HISTORICAL COMPARISON

The average seasonal rainfall from 1900 to 2019 in Saskatoon is 264 mm which is depicted by the light blue line in Figure 4. The 2019 seasonal rainfall of 258 mm was slightly below average. The lowest seasonal rainfall occurred in 2001 with 131 mm and the highest seasonal rainfall occurred in 2010 with 569 mm. A table containing the seasonal rainfalls from 1900 to 2019 can be found in Appendix A.

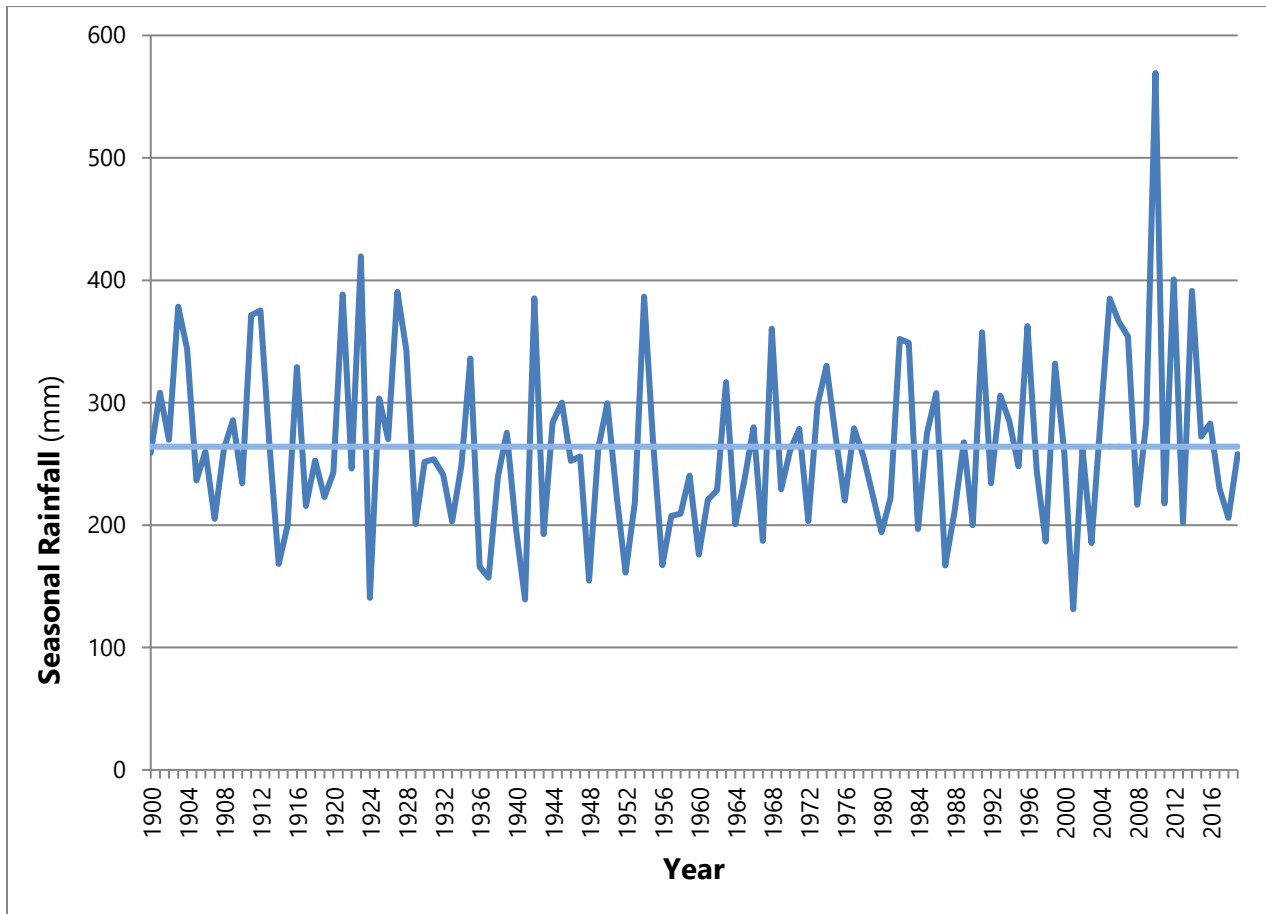


Figure 4: Seasonal rainfall (1900-2019).



HISTORICAL COMPARISON

The following graph provides a comparison of the maximum amount of rainfall to occur in a single day in each season. The average maximum rainfall in a single day in a season is 36 mm from the years 1900 to 2019 and is represented by the light blue line in Figure 5. During the 2019 rainfall season, the maximum rainfall to occur within a single day was 37 mm, which occurred on June 22nd. This is the 45th highest rainfall to occur in a single day out of the 120 years of data.

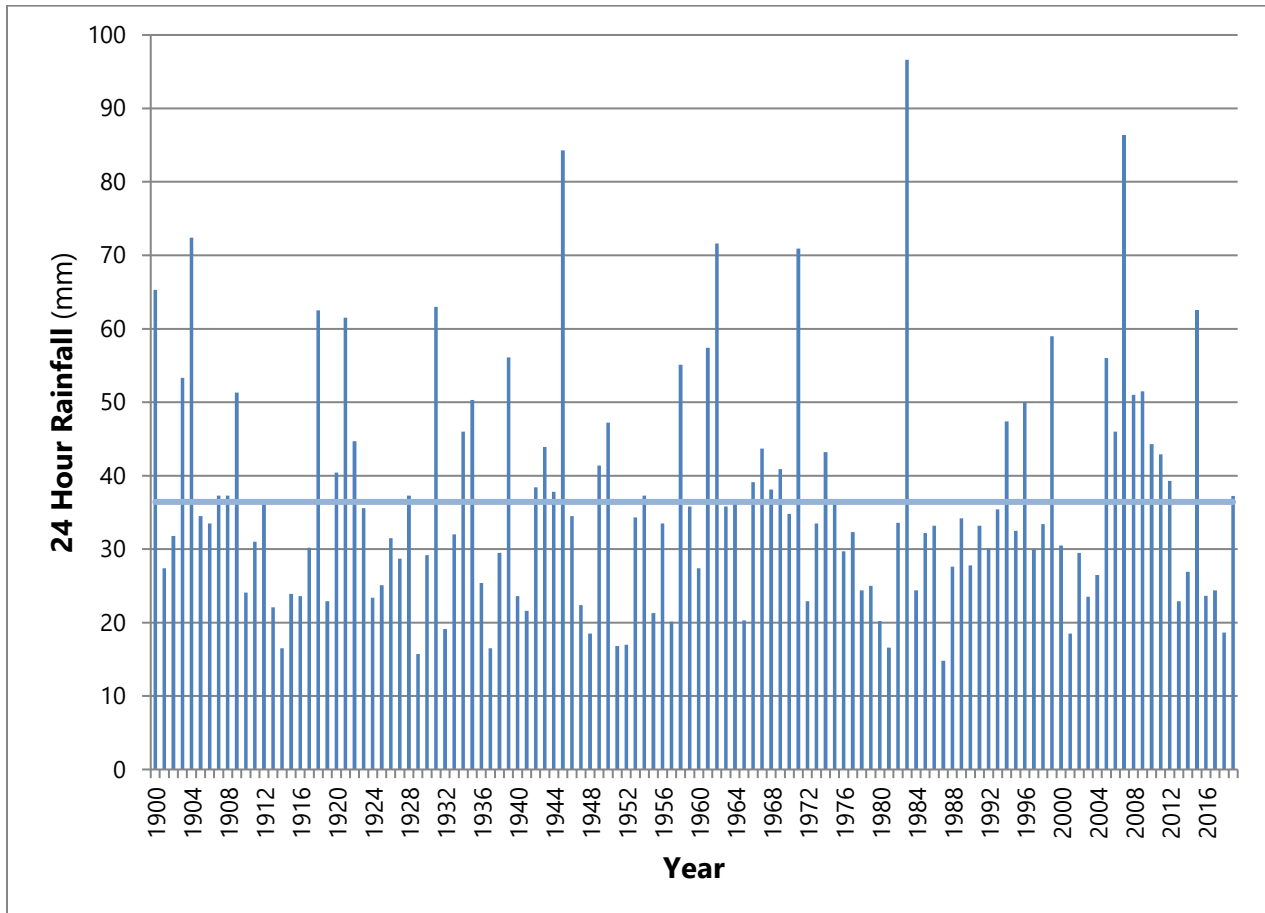


Figure 5: Maximum daily rainfall.

As can be seen in the graph above, the lowest maximum daily rainfall occurred on July 19th, 1987, with a total of 15 mm and the highest occurred on June 24th, 1983 with a total of 97 mm.



CLASSIFYING RAIN EVENTS

Rain events in Saskatoon are often localized. Therefore, a rain event may only occur at a few of the seven rain gauges located throughout the city. In order to compare the severity of rain events, their return period must be determined. A return period provides an indication of the likelihood of an event. For example, a rain event with a return period of 2 years has a 50% chance of occurring in any given year. For comparison, a rain event with a return period of 100 years has a 1% chance of occurring in any given year. The following table provides a summary of the criteria used to determine the return period of each rain event.

Table 2: Criteria for determining return period of a rain event.

Time (minutes)	Intensity (mm/hr)			
	2-Year	5-Year	25-Year	100-Year
10	53	85	132	168
15	41	67	104	133
30	26.4	46.1	74	97
60	16.6	28.9	46.5	60
120	10.7	17.5	27.3	35
360	4.7	7.0	10.3	12.9
720	2.73	3.90	5.59	6.91
1440	1.56	2.18	3.07	3.76

For the purposes of this report, two different methods were utilized to determine the number of rain events with a return period of 2, 5, 25, or 100 years between 2012 and 2019. It should be noted that within this report, rain events with the same return period may include any of the durations as outlined in Table 2. The first method determined the average number of rain events for each return period by adding together the number of events in a season with the same return period at each of the city's rain gauges and dividing that number by the total number of rain gauges (seven). The following table provides a summary of these values. A more detailed table can be found in Appendix B.

Table 3: Average frequency of rain events.

	Return Period	2012	2013	2014	2015	2016	2017	2018	2019	Total
Average	2 – 5 Year	4	1	3	1	1	1	1	3	15
	5 – 25 Year	0	0	0	1	0	0	0	0	1
	25 – 100 Year	0	0	0	0	0	0	0	0	0
	> 100 Years	0	0	0	0	0	0	0	0	0
	Total	4	1	3	2	1	1	1	3	16



CLASSIFYING RAIN EVENTS

In Table 4, the rain events were tallied using the same method as Table 3, except only rain events with a duration of 1 hour or greater were counted.

Table 4: Average frequency of rain events greater than or equal to 1 hour duration.

	Return Period	2012	2013	2014	2015	2016	2017	2018	2019	Total
Average	2 – 5 Year	3	1	2	1	0	1	0	1	9
	5 – 25 Year	0	0	0	1	0	0	0	0	1
	25 – 100 Year	0	0	0	0	0	0	0	0	0
	> 100 Years	0	0	0	0	0	0	0	0	0
	Total	3	1	2	2	0	1	0	0	10

The second method determined the number of days per year that a major rain event occurred at one or more rain gauges. If the rain gauges throughout the City recorded varying return periods on a given day, the maximum return period was counted as the rain event for that day. The following table provides the number of days per year that a major rain event occurred at one or more rain gauges.

Table 5: Overall frequency of rain events.

	Return Period	2012	2013	2014	2015	2016	2017	2018	2019	Total
Overall	2 – 5 Year	8	5	6	3	3	2	3	5	35
	5 – 25 Year	0	1	1	0	0	1	0	2	5
	25 – 100 Year	0	0	0	1	0	0	0	0	1
	> 100 Years	0	0	0	0	0	0	0	0	0
	Total	8	6	7	4	3	3	3	7	41

In Table 6, the days per year were tallied using the same method as Table 5, except only days with a rain event of 1 hour duration or greater were counted.

Table 6: Overall frequency of rain events greater than or equal to 1 hour duration.

	Return Period	2012	2013	2014	2015	2016	2017	2018	2019	Total
Overall	2 – 5 Year	6	4	3	1	2	1	2	2	21
	5 – 25 Year	0	0	0	0	0	1	0	0	1
	25 – 100 Year	0	0	0	1	0	0	0	0	1
	> 100 Years	0	0	0	0	0	0	0	0	0
	Total	6	4	3	2	2	2	2	2	23



CONCLUSION

Overall, the 2019 rainfall season had an accumulation which was slightly less than the historical seasonal average. Despite the lower than average seasonal rainfall, 5 rain events occurred with a return period of 2-5 years and 2 rain events occurred with a return period of 5-25 years. Based on a weighted average, the maximum rainfall to occur within a single day was 37 mm, which occurred on June 22nd.



APPENDICES

Appendix A – Total Seasonal Rainfall (1900-2019)



APPENDIX A

Year	Rain (mm)	Rank	Year	Rain (mm)	Rank	Year	Rain (mm)	Rank
1900	259	58	1942	385	8	1984	197	103
1901	308	27	1943	193	106	1985	275	44
1902	270	48	1944	284	37	1986	308	28
1903	379	10	1945	300	31	1987	167	113
1904	344	20	1946	252	64	1988	211	91
1905	236	74	1947	256	61	1989	268	50
1906	260	56	1948	155	117	1990	200	101
1907	205	95	1949	263	52	1991	358	16
1908	262	53	1950	300	32	1992	234	76
1909	286	35	1951	224	82	1993	306	29
1910	234	77	1952	161	115	1994	285	36
1911	371	12	1953	218	87	1995	248	67
1912	375	11	1954	387	7	1996	362	14
1913	266	51	1955	268	49	1997	244	69
1914	168	111	1956	167	112	1998	187	108
1915	200	102	1957	208	93	1999	332	23
1916	329	25	1958	209	92	2000	259	57
1917	216	90	1959	241	72	2001	131	120
1918	253	63	1960	176	110	2002	262	54
1919	223	83	1961	221	85	2003	185	109
1920	243	70	1962	229	80	2004	288	34
1921	389	6	1963	317	26	2005	385	9
1922	246	68	1964	201	100	2006	366	13
1923	420	2	1965	236	75	2007	354	17
1924	141	118	1966	280	40	2008	217	89
1925	303	30	1967	187	107	2009	284	38
1926	270	47	1968	360	15	2010	569	1
1927	391	5	1969	229	79	2011	218	88
1928	343	21	1970	261	55	2012	401	3
1929	201	99	1971	279	42	2013	202	98
1930	252	65	1972	203	96	2014	391	4
1931	254	62	1973	298	33	2015	272	45
1932	241	71	1974	330	24	2016	283	39
1933	203	97	1975	271	46	2017	230	78
1934	249	66	1976	220	86	2018	206	94
1935	336	22	1977	279	41	2019	258	59
1936	166	114	1978	256	60			
1937	157	116	1979	226	81			
1938	239	73	1980	194	105			
1939	275	43	1981	222	84			
1940	196	104	1982	352	18			
1941	139	119	1983	349	19			



APPENDICES

Appendix B – Return Period of Rain Events by Rain Gauge



APPENDIX B

	Return Period	2012	2013	2014	2015	2016	2017	2018	2019	Total
Waste Water Treatment Plant	2 - 5 Year	4	0	3	1	1	1	1	3	14
	5 - 25 Year	0	0	0	1	0	0	0	1	2
	25 - 100 Year	0	0	0	0	0	0	0	0	0
	> 100 Year	0	0	0	0	0	0	0	0	0
	Total	4	0	3	2	1	1	1	4	16
Woodlawn	2 - 5 Year	5	1	3	2	1	1	0	4	17
	5 - 25 Year	0	1	0	1	0	0	0	0	2
	25 - 100 Year	0	0	0	0	0	0	0	0	0
	> 100 Year	0	0	0	0	0	0	0	0	0
	Total	5	2	3	3	1	1	0	4	19
Shaw Centre	2 - 5 Year	5	2	5	3	1	1	1	2	20
	5 - 25 Year	0	0	0	1	0	0	0	0	1
	25 - 100 Year	0	0	0	0	0	0	0	0	0
	> 100 Year	0	0	0	0	0	0	0	0	0
	Total	5	2	5	4	1	1	1	2	21
Nicholson Yards	2 - 5 Year	2	0	2	1	0	n/a	n/a	n/a	5
	5 - 25 Year	0	0	1	1	0	n/a	n/a	n/a	2
	25 - 100 Year	0	0	0	0	0	n/a	n/a	n/a	0
	> 100 Year	0	0	0	0	0	n/a	n/a	n/a	0
	Total	2	0	3	2	0	n/a	n/a	n/a	7
Light and Power	2 - 5 Year	2	2	3	0	1	0	1	4	13
	5 - 25 Year	0	0	0	0	0	1	0	0	1
	25 - 100 Year	0	0	0	1	0	0	0	0	1
	> 100 Year	0	0	0	0	0	0	0	0	0
	Total	2	2	3	1	1	1	1	4	15
City Hall	2 - 5 Year	5	3	4	1	1	1	2	2	19
	5 - 25 Year	0	0	0	0	0	0	0	1	1
	25 - 100 Year	0	0	0	1	0	0	0	0	1
	> 100 Year	0	0	0	0	0	0	0	0	0
	Total	5	3	4	2	1	1	2	3	21
Attridge Fire Hall	2 - 5 Year	1	1	1	1	0	0	0	2	6
	5 - 25 Year	0	0	0	1	0	0	0	0	1
	25 - 100 Year	0	0	0	0	0	0	0	0	0
	> 100 Year	0	0	0	0	0	0	0	0	0
	Total	1	1	1	2	0	0	0	2	7
Acadia Reservoir	2 - 5 Year	4	1	2	1	2	2	0	2	14
	5 - 25 Year	0	0	0	1	0	0	0	1	2
	25 - 100 Year	0	0	0	0	0	0	0	0	0
	> 100 Year	0	0	0	0	0	0	0	0	0
	Total	4	1	2	2	2	2	0	3	16