

2021 Annual Rainfall Report

Monitoring and Modeling



Saskatoon Water
Utilities and Environment Division



EXECUTIVE SUMMARY

The following report provides a summary of Saskatoon's 2021 rainfall season (April to September) and a comparison with historical rainfall. Highlights of the report include the following:

- In 2021, 146 mm of rainfall accumulated, which was less than the historical average of 264 mm and the 4th lowest seasonal rainfall total out of 122 years since 1900.
- On average, rainfall occurred on 23% of days in 2021.
- Based on the weighted average, 36 mm was the largest amount of rainfall to accumulate in a single day.
- Saskatoon had a dry spring in 2021. The average rainfall between April and June since 1900 is 127 mm. Saskatoon received 73 mm which falls in the 16th percentile for this time period.
- Saskatoon had a dry summer in 2021. The average rainfall between July and September since 1900 is 136 mm. Saskatoon received 73 mm which falls in the 6th percentile for this time period.
- 2021 had an average of one rain event with a return period of 2-5 years.
- At one or more of the eight rain gauges, a 5-25 year rain event occurred on May 24th and 2-5 year rain events occurred on June 10th and August 23rd, 2021.



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INTRODUCTION

The purpose of this report is to provide a summary of the 2021 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 2021 data was obtained from eight City of Saskatoon rain gauges. The name, location, approximate area, and total seasonal rainfall of each rain gauge is shown below.

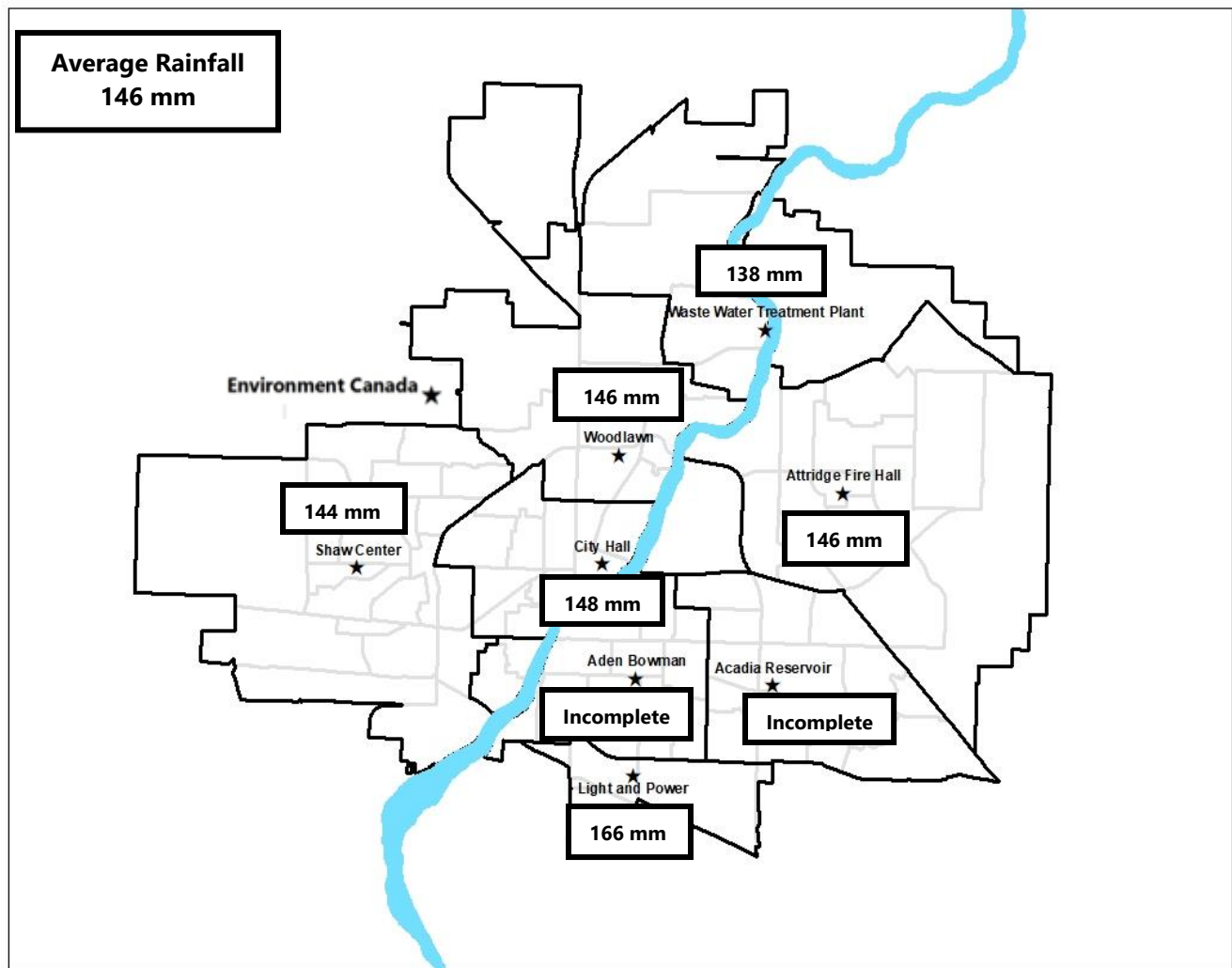


Figure 1: Overview of rain gauges.



SUMMARY OF RAINFALL IN 2021

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 2021 rainfall season.

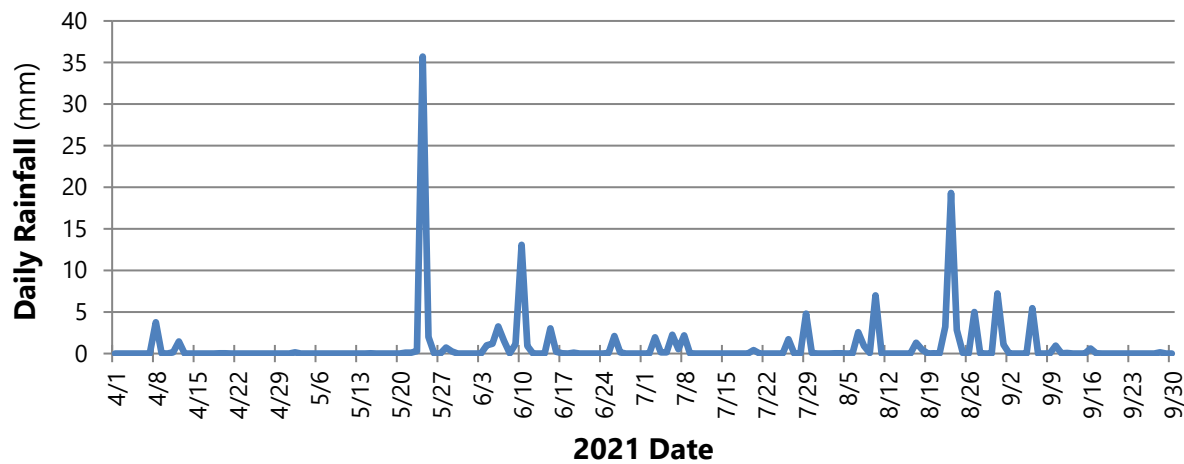


Figure 2: 2021 daily rainfall.

Based on the weighted average, the largest amount of rainfall occurred on May 24th, 2021 with a total of 36 mm. This rainfall accounted for approximately 25% of the total rainfall that occurred in 2021.

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	25%	15%	5%	2%	0%
Attridge Fire Hall	22%	15%	5%	2%	1%
Aden Bowman	18%	11%	4%	1%	1%
City Hall	23%	14%	4%	2%	1%
Light and Power	24%	13%	4%	2%	1%
Shaw Center	19%	11%	4%	2%	1%
WWTP	23%	15%	3%	1%	1%
Woodlawn	27%	14%	4%	1%	1%
Average	23%	13%	4%	2%	1%

On average, rainfall occurred on 23% of days in 2021.



SUMMARY OF RAINFALL IN 2021

The daily weighted average rainfall was added together to calculate the total seasonal rainfall. The total seasonal rainfall for 2021 was 146 mm. Figure 3 depicts the accumulation of rainfall throughout the 2021 season.

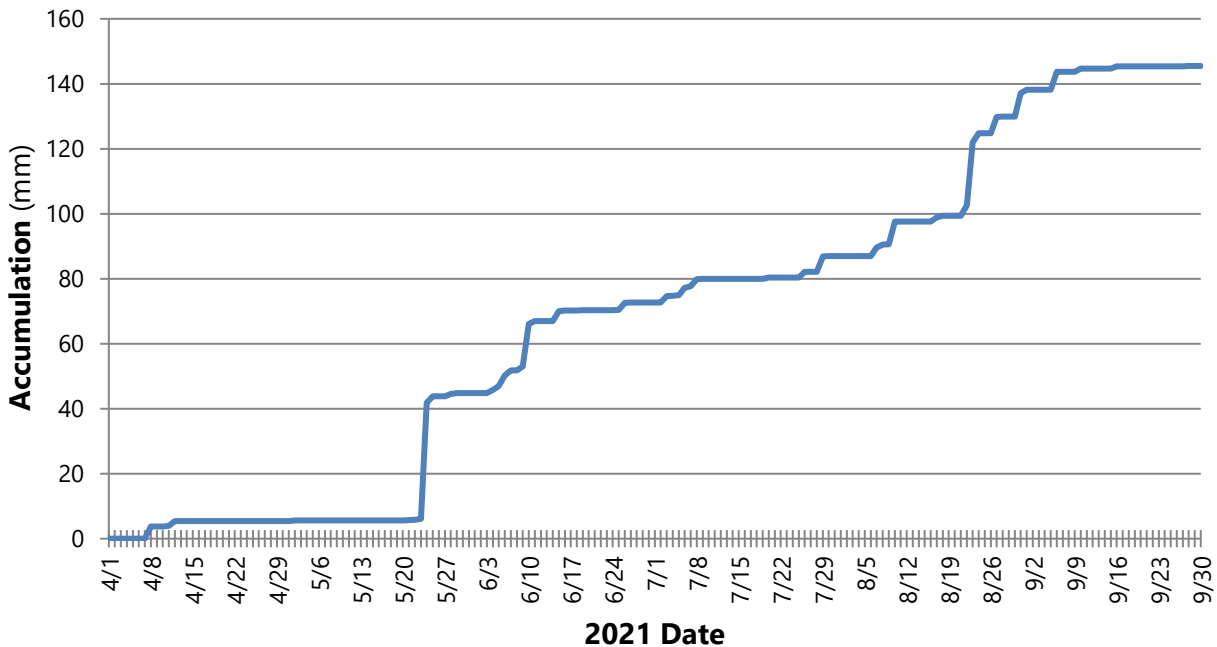


Figure 3: 2021 rainfall accumulation.

The 2021 rainfall season experienced a dry spring accumulating a total of 73 mm of rain, which was the 15th lowest spring rainfall out of 122 years since 1900. The total rainfall between July and September was also 73 mm which was the 9th lowest summer rainfall out of 122 years since 1900.



HISTORICAL COMPARISON

The average seasonal rainfall from 1900 to 2021 in Saskatoon is 264 mm which is depicted by the light blue line in Figure 4. The 2021 seasonal rainfall of 146 mm was significantly below average and the 4th lowest rainfall out of 122 years since 1900. 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 2021 can be found in Appendix A.

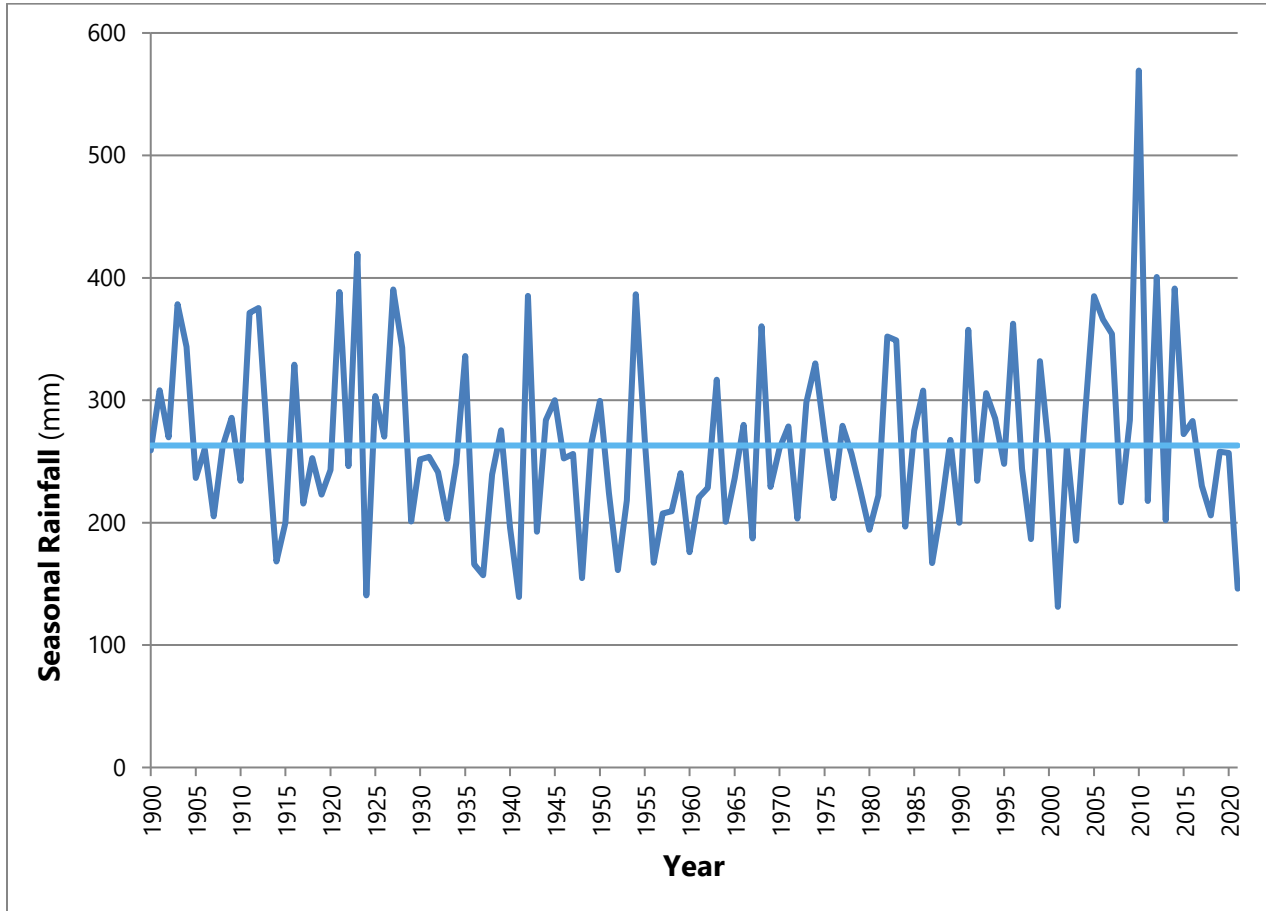


Figure 4: Seasonal rainfall (1900-2021).



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 2021 and is represented by the light blue line in Figure 5. During the 2021 rainfall season, the maximum rainfall to occur within a single day was 36 mm, which was on May 24th.

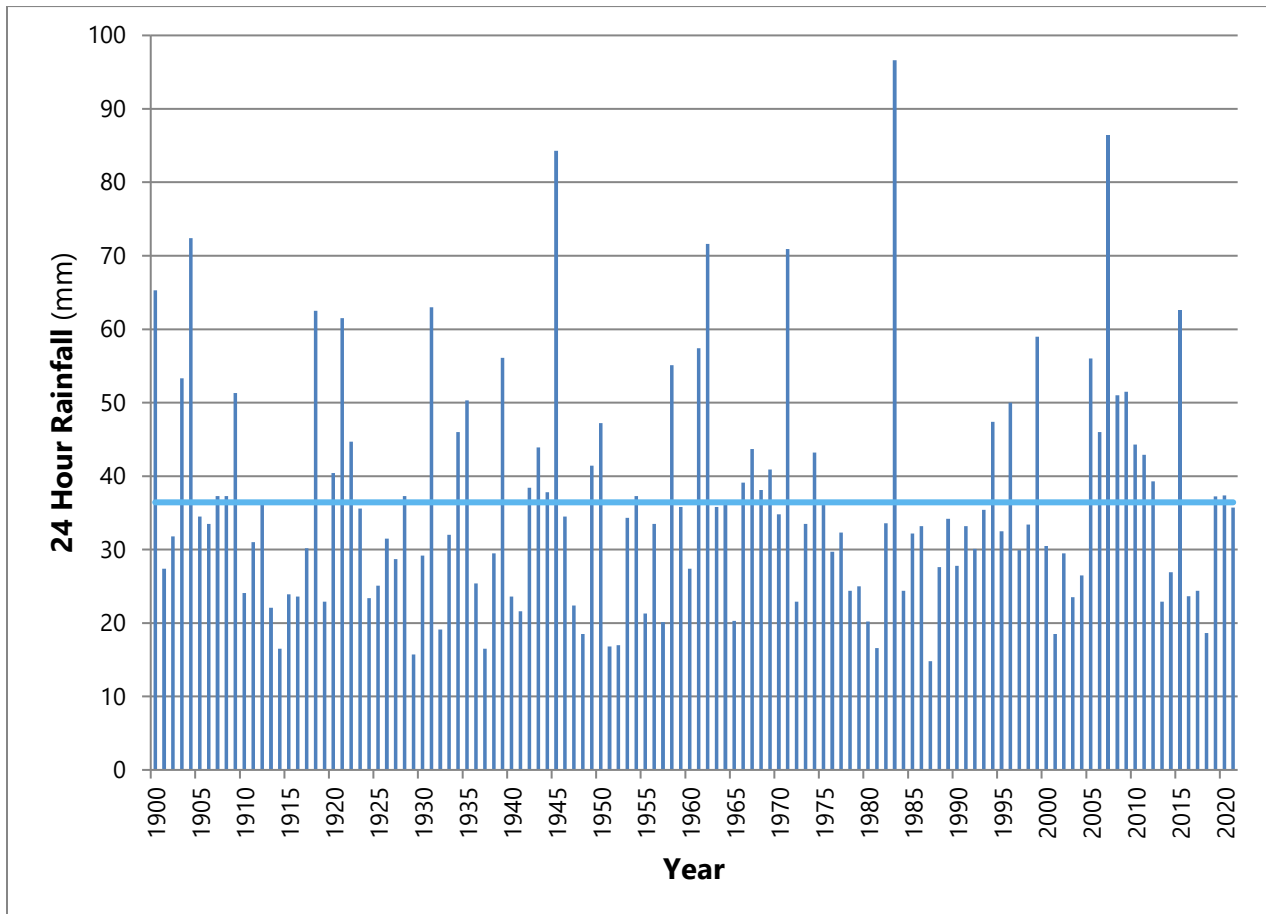


Figure 5: Maximum daily rainfall.

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 eight 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 2021. 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. 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	2020	2021	Total
Average	2 – 5 Year	4	1	3	1	1	1	1	3	2	1	18
	5 – 25 Year	0	0	0	1	0	0	0	0	0	0	1
	25 – 100 Year	0	0	0	0	0	0	0	0	0	0	0
	> 100 Years	0	0	0	0	0	0	0	0	0	0	0
	Total	4	1	3	2	1	1	1	3	2	1	19



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	2020	2021	Total
Average	2 – 5 Year	3	1	2	1	0	1	0	1	2	1	12
	5 – 25 Year	0	0	0	1	0	0	0	0	0	0	1
	25 – 100 Year	0	0	0	0	0	0	0	0	0	0	0
	> 100 Years	0	0	0	0	0	0	0	0	0	0	0
	Total	3	1	2	2	0	1	0	1	2	1	13

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	2020	2021	Total
Overall	2 – 5 Year	8	5	6	3	3	2	3	5	2	2	39
	5 – 25 Year	0	1	1	0	0	1	0	2	0	1	6
	25 – 100 Year	0	0	0	1	0	0	0	0	0	0	1
	> 100 Years	0	0	0	0	0	0	0	0	0	0	0
	Total	8	6	7	4	3	3	3	7	2	3	46

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	2020	2021	Total
Overall	2 – 5 Year	6	4	3	1	2	1	2	2	2	1	24
	5 – 25 Year	0	0	0	0	0	1	0	0	0	1	2
	25 – 100 Year	0	0	0	1	0	0	0	0	0	0	1
	> 100 Years	0	0	0	0	0	0	0	0	0	0	0
	Total	6	4	3	2	2	2	2	2	2	2	27



CONCLUSION

Overall, the 2021 rainfall season had an accumulation which was significantly less than the historical seasonal average. Despite the low seasonal rainfall, three rain events occurred, two with a return period of 2-5 years and one with a return period of 5-25 years. Based on a weighted average, the maximum rainfall to occur within a single day was 36 mm, which was on May 24th, 2021.



APPENDICES

Appendix A – Total Seasonal Rainfall (1900-2021)



APPENDIX A

Year	Rain (mm)	Rank	Year	Rain (mm)	Rank	Year	Rain (mm)	Rank
1900	259	58	1942	385	8	1984	197	104
1901	308	27	1943	193	107	1985	275	44
1902	270	48	1944	284	37	1986	308	28
1903	379	10	1945	300	31	1987	167	114
1904	344	20	1946	252	65	1988	211	92
1905	236	75	1947	256	62	1989	268	50
1906	260	56	1948	155	118	1990	200	102
1907	205	96	1949	263	52	1991	358	16
1908	262	53	1950	300	32	1992	234	77
1909	286	35	1951	224	83	1993	306	29
1910	234	78	1952	161	116	1994	285	36
1911	371	12	1953	218	88	1995	248	68
1912	375	11	1954	387	7	1996	362	14
1913	266	51	1955	268	49	1997	244	70
1914	168	112	1956	167	113	1998	187	109
1915	200	103	1957	208	94	1999	332	23
1916	329	25	1958	209	93	2000	259	57
1917	216	91	1959	241	73	2001	131	122
1918	253	64	1960	176	111	2002	262	54
1919	223	84	1961	221	86	2003	185	110
1920	243	71	1962	229	81	2004	288	34
1921	389	6	1963	317	26	2005	385	9
1922	246	69	1964	201	101	2006	366	13
1923	420	2	1965	236	76	2007	354	17
1924	141	120	1966	280	40	2008	217	90
1925	303	30	1967	187	108	2009	284	38
1926	270	47	1968	360	15	2010	569	1
1927	391	5	1969	229	80	2011	218	89
1928	343	21	1970	261	55	2012	401	3
1929	201	100	1971	279	42	2013	202	99
1930	252	66	1972	203	97	2014	391	4
1931	254	63	1973	298	33	2015	272	45
1932	241	72	1974	330	24	2016	283	39
1933	203	98	1975	271	46	2017	230	79
1934	249	67	1976	220	87	2018	206	95
1935	336	22	1977	279	41	2019	258	59
1936	166	115	1978	256	61	2020	257	60
1937	157	117	1979	226	82	2021	146	119
1938	239	74	1980	194	106			
1939	275	43	1981	222	85			
1940	196	105	1982	352	18			
1941	139	121	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	2020	2021	Total
Waste Water Treatment Plant	2 - 5 Year	4	0	3	1	1	1	1	3	1	1	16
	5 - 25 Year	0	0	0	1	0	0	0	1	0	0	2
	25 - 100 Year	0	0	0	0	0	0	0	0	0	0	0
	> 100 Year	0	0	0	0	0	0	0	0	0	0	0
	Total	4	0	3	2	1	1	1	1	4	1	1
Woodlawn	2 - 5 Year	5	1	3	2	1	1	0	4	2	0	19
	5 - 25 Year	0	1	0	1	0	0	0	0	0	0	2
	25 - 100 Year	0	0	0	0	0	0	0	0	0	0	0
	> 100 Year	0	0	0	0	0	0	0	0	0	0	0
	Total	5	2	3	3	1	1	0	4	1	0	21
Shaw Centre	2 - 5 Year	5	2	5	3	1	1	1	2	1	2	23
	5 - 25 Year	0	0	0	1	0	0	0	0	0	0	1
	25 - 100 Year	0	0	0	0	0	0	0	0	0	0	0
	> 100 Year	0	0	0	0	0	0	0	0	0	0	0
	Total	5	2	5	4	1	1	1	2	1	2	24
Nicholson Yards	2 - 5 Year	2	0	2	1	0						5
	5 - 25 Year	0	0	1	1	0						2
	25 - 100 Year	0	0	0	0	0						0
	> 100 Year	0	0	0	0	0						0
	Total	2	0	3	2	0						
Light and Power	2 - 5 Year	2	2	3	0	1	0	1	4		2	15
	5 - 25 Year	0	0	0	0	0	1	0	0		0	1
	25 - 100 Year	0	0	0	1	0	0	0	0		0	1
	> 100 Year	0	0	0	0	0	0	0	0		0	0
	Total	2	2	3	1	1	1	1	4		2	17
City Hall	2 - 5 Year	5	3	4	1	1	1	2	2	2	1	22
	5 - 25 Year	0	0	0	0	0	0	0	1	0	0	1
	25 - 100 Year	0	0	0	1	0	0	0	0	0	0	1
	> 100 Year	0	0	0	0	0	0	0	0	0	0	0
	Total	5	3	4	2	1	1	2	3	2	1	24
Attridge Fire Hall	2 - 5 Year	1	1	1	1	0	0	0	2		0	6
	5 - 25 Year	0	0	0	1	0	0	0	0		0	1
	25 - 100 Year	0	0	0	0	0	0	0	0		0	0
	> 100 Year	0	0	0	0	0	0	0	0		0	0
	Total	1	1	1	2	0	0	0	0	2		0
Aden Bowman	2 - 5 Year									1	0	1
	5 - 25 Year									0	0	0
	25 - 100 Year									0	0	0
	> 100 Year									0	0	0
	Total									1	0	1
Acadia Reservoir	2 - 5 Year	4	1	2	1	2	2	0	2	2	0	16
	5 - 25 Year	0	0	0	1	0	0	0	1	0	1	3
	25 - 100 Year	0	0	0	0	0	0	0	0	0	0	0
	> 100 Year	0	0	0	0	0	0	0	0	0	0	0
	Total	4	1	2	2	2	2	0	3	2	1	19