

RED RIVER FLOODWAY OPERATION REPORT

SPRING 2022

January 16, 2023

Manitoba Infrastructure
Hydrologic Forecasting and Water Management Branch
Water Management and Structures Division



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EXECUTIVE SUMMARY

The 2022 Red River spring flood resulted from normal to extremely above normal winter snow fall in the Red River basin, including record high winter precipitation in portions of the US, combined with normal to above normal soil moisture going into freeze-up in the fall. The March Outlook published by Manitoba's Hydrologic Forecast Center estimated that the peak flow at Emerson would be similar to the flow seen in the spring of 2019 under favorable conditions, and similar to the 2020 flood under normal conditions. Under unfavorable conditions, the 2022 flow at Emerson was forecast to be similar to 2011. Due to a slow thaw with significant spring precipitation, the observed peak at Emerson for the 2022 spring flood was approximately 81,900 cfs (2320 m³/s), and occurred over May 7 and 8. This is slightly higher than the peak flow observed at Emerson in 2011. The 2022 peak flow measured at Emerson equated to a 1:27 year flood.

Ice was not a major concern on the Red or Assiniboine Rivers in 2022; however, some ice jamming did occur north of the City of Winnipeg in the Selkirk area. Floodway operation began at 9:44 a.m. on April 8, and the gates were operated for 61 days ending at 3:22 p.m. on June 16; there was a period of 7 days from April 16 – 22 where the Floodway was not operated and there was no flow in the floodway channel. During the spring 2022 period of operation, 153 discrete gate adjustments were made, as required at various times, to regulate the water level at the floodway inlet. In the spring of 2022, approximately 3.32 million acre-feet (4093 million m³) of water was diverted around the City of Winnipeg by the Red River Floodway, with a peak flow of 43,200 cfs (1223.2 m³/s). The Red River Floodway has been operated in 35 of the past 53 years to reduce high water levels in the City of Winnipeg since its first year of operation in 1969.

The Assiniboine River flow during the spring flood of 2022 was above average for the spring freshet. The natural (unregulated) peak flow along the Assiniboine River at Portage la Prairie occurred on May 25, and was computed to be 18,400 cfs (521.2 m³/s). The observed flow along the Assiniboine River at Headingley reached a maximum of 11,000 cfs (312.3 m³/s) due to the operation of the Shellmouth Dam and Portage Diversion.

In spring 2022, the operation of the floodway was successful in protecting the City of Winnipeg from flooding, while minimizing upstream impacts through normal floodway operation under Rule 1 of the Red River Floodway Rules of Operation, which sets out the conditions by which the floodway can be used to protect Winnipeg. Rule 1 requires that natural water levels are maintained on the Red River at the floodway inlet. On average, the operation of the Red River Floodway maintained river levels 0.40 ft (0.12 m) below computed natural water levels at the floodway inlet throughout the 61 days of floodway operation. In concert with the operation of the Portage Diversion and Shellmouth Dam, the operation of the floodway reduced the flood crest in the City of Winnipeg by 9.51 ft (2.90 m) at the natural flow crest. The recorded peak water level at James Avenue was 18.99 ft (5.79 m).

TABLE OF CONTENTS

	Page
EXECUTIVE SUMMARY	i
TABLE OF CONTENTS.....	ii
1.0 INTRODUCTION	1
2.0 2022 SPRING RUNOFF.....	1
3.0 THE RED RIVER FLOODWAY	2
4.0 OPERATION OF THE FLOODWAY IN SPRING 2022.....	2
4.1 General Observations	2
4.2 Public Communication in 2022 Flood.....	3
4.3 Ice Conditions in 2022.....	4
4.4 Assiniboine River Flow Contribution	4
4.5 Floodway Maintenance and Efficiency	5
5.0 CONCLUSIONS.....	5

TABLES

Table 1: 2022 Spring Floodway Gate Operations

FIGURES

Figure 1: Recorded and Natural River Levels at James Avenue 2022

Figure 2: Recorded and Natural Levels at Floodway Entrance 2022

APPENDICES

Appendix A: Red River Floodway Rules of Operation

Appendix B: Computation of Natural Flows and Levels

1.0 INTRODUCTION

On April 20, 2005, The Red River Floodway Act was proclaimed into force. Subsection 11(1) of this act states that:

“On or before June 30 of any year in which the government operates the floodway during spring flooding to regulate the river level, the director must provide the minister with a report about the operation containing the information the minister requires.”

The 2022 Floodway Operation Report was delayed by the extremely long and widespread spring flood, which required significant additional effort post-event to process the hydrologic data. The following report details operation of the Red River Floodway in the spring runoff period of 2022 as required by section 11(1) of The Red River Floodway Act and includes the information specified in section 3(1) of The Red River Floodway Regulation.

Within the charts and tables in this report, all flows and levels are shown in imperial units. Flows can be converted from cubic feet per second (cfs) to cubic metres per second (m³/s) by dividing by 35.3147. River levels can be converted from feet to metres by dividing by a factor of 3.28084. Water levels within the City of Winnipeg reference the James Avenue Pumping Station Datum (JAPSD), which is based on the normal winter ice level in the city. This datum has been the traditional reference for water levels used by the City of Winnipeg, and is the datum used for reference water levels specified in the Red River Floodway Rules of Operation. Geodetic elevations can be converted to the James Avenue datum by subtracting 727.57 ft (221.763 m).

This report refers to “natural” flows and water levels. Natural flows are the flows that would have occurred in the absence of flood control works (unregulated conditions). Natural water levels refer to the water levels that would have occurred in the absence of flood control and with the level of urban development in place at the time of the construction of these various works.

Manitoba Transportation and Infrastructure gratefully acknowledges Water Survey Canada for providing the provisional and approved flow data used in this report.

2.0 2022 SPRING RUNOFF

The 2022 Red River spring flood resulted from normal (85% - 115%) to above normal (115% - 150%) soil moisture in the Red River basin, combined with normal (85% - 115%) to extremely above normal (>200%) winter precipitation. The US portion of the basin generally saw well above normal (150% - 200%) to extremely above normal (>200%) precipitation over winter. The northern part of the basin, including southeast Manitoba, saw normal (85% - 115%) to well above normal (150% - 200%) precipitation over winter. The March Outlook published by Manitoba’s Hydrologic Forecast Center estimated that the peak flow at Emerson could be similar to the flow seen in the 2019 spring flood under favorable conditions, and similar to the 2020 flood under normal conditions. Under unfavorable conditions, the 2022 flow at Emerson was forecast to be similar to the 2011 flow.

The recorded peak flow was slightly higher than the forecast peak for unfavourable melt conditions published in the March Outlook. Despite the high winter precipitation and normal to above normal antecedent moisture conditions in the U.S. portions of the Red River and Souris River basins, a slow melt gave initial indications of more favourable conditions. However, a series of intense precipitation events throughout the spring resulted in high flows across the Red River basin. Much of the Red River basin received in excess of 330 mm between April 1 and June 19, which is greater than 200% of normal. The observed peak at Emerson for the 2022 spring flood occurred on May 7 and 8, and was approximately 81,900 cfs (2320 m³/s). The Red River crested at the floodway inlet on May 13, with a peak flow of approximately 85,000 cfs (2407 m³/s).

The 2022 natural spring flood was a significant event in the basin, with extensive flooding and a prolonged duration of high flows. The 2022 peak flow measured at Emerson equated to a 1:27 year flood. The peak natural flood flow at James Avenue equated to a 1:18 year flood.

3.0 THE RED RIVER FLOODWAY

Following the historic flood of 1950 in the City of Winnipeg, work began on the design and construction of a series of flood control measures including the Shellmouth Dam and Reservoir, the Portage Diversion, and the Red River Floodway to protect the City of Winnipeg from significant flood events. All were intended to be operated in concert to reduce flood flows and thus, minimize flood damage within the City of Winnipeg.

Operation of the floodway is guided by the Red River Floodway Rules of Operation (Appendix A), a set of rules intended to provide balanced flood protection to the City of Winnipeg without artificially affecting properties south (e.g., upstream) of the inlet. Rule 1 requires that natural levels not be exceeded upstream of the Floodway Inlet Control Structure as long as water levels within the City of Winnipeg are less than 24.5 ft (7.47 m) at James Avenue or if the water level anywhere along the Red River within the City of Winnipeg is less than two feet below the Flood Protection Level of 27.83 ft (8.48m). The natural water level on the Red River at the floodway entrance is defined as the water level that would have occurred at this location in the late 1950s if the Shellmouth Reservoir, Portage Diversion, Assiniboine River dikes, Winnipeg dikes and Red River Floodway were not in place.

During the 2022 spring floodway operation, the natural water levels upstream of the inlet were calculated using the relationship developed by Acres Manitoba Limited in 2004 [*Re-Computation of Natural Water Levels at the Floodway Inlet (Final Report)*, April 2004]. This relationship requires two input values: the natural flow in the Red River downstream of the Assiniboine River (at James Avenue) and the natural flow of the Assiniboine River into the Red River. These data along with the natural and actual water levels on the Red River at the floodway inlet are shown for the 2022 spring flood in Appendix B, Table 2. Real-time water level and flow data to guide the operations are obtained at a number of sites, including the Red River at James Avenue, Red River above and below the Inlet Control Structure, Floodway Channel, Assiniboine River at Headingley, Portage Diversion, Sturgeon Creek, and La Salle River along with estimates of un-gauged flow from small streams or overland runoff in the Winnipeg area.

4.0 OPERATION OF THE FLOODWAY IN SPRING 2022

4.1 General Observations

Floodway operation began at 9:44 a.m. on April 8. Water had begun to spill into the floodway on April 4; however, ice was still in place immediately upstream of the Floodway Control Structure until the morning of the 8th. The Red River Floodway gates were operated in accordance with normal operating procedures to reduce river levels in the City of Winnipeg. Operation of the floodway during open water in 2022 followed normal protocol and was consistent with experience in past spring floods.

The computation of natural water levels at the Red River Floodway Inlet Control Structure requires calculation of the natural flow at James Avenue. Natural flow is determined by adjusting the actual flow for the effects of the flood control works. Under open water conditions, the actual flow is determined from an established water level-flow relationship for the Red River at James Avenue using water levels collected at Water Survey of Canada water monitoring station 05OC015, and considers the backwater influence of the Red River floodway at Lockport. This water level-flow relationship is verified multiple times throughout the spring through manual flow measurements.

The recorded instantaneous peak water level at James Avenue was 18.99 ft (5.79 m) under open water conditions on the evening of April 30. The peak natural flow at James Avenue in Winnipeg would have occurred on the morning of May 15, and was calculated to be approximately 101,250 cfs (2867.1 m³/s). This peak flow would have resulted in a James Avenue level of 27.68 ft (8.44 m). Operation of the floodway, Portage Diversion and Shellmouth Dam lowered the James Avenue water level during the peak natural flow by 9.51 ft (2.90 m), to a level of 18.16 ft (5.54 m).

Overall, in the spring of 2022, approximately 3.32 million acre-feet (4093 million m³) of water was diverted around the City of Winnipeg by the Red River Floodway, with a peak flow of 43,200 cfs (1223.2 m³/s). The peak recorded level at the floodway entrance (Water Survey Canada station 05OC026) was 764.74 ft (233.09 m) on May 13, 0.31 ft (0.10 m) lower than the computed natural level of 765.05 ft (233.19 m). The water level at the floodway inlet did exceed natural during the initial days of the second operating period in response to rapidly increasing flows in the river. These exceedances were on the order of 2.5" (6 cm), occurred for brief periods of time, and did not impact the peak levels observed upstream of the floodway. The recorded river level at the floodway entrance was maintained at an average of 0.40 ft (0.12 m) below the computed natural level during the 2022 spring floodway operation.

After the raises that initiated each period of operation, the floodway gates were adjusted in small increments to follow the natural rise and drop in water levels. This was done to avoid large gate raises and drops that may have caused sudden changes in water levels above and below the floodway control structure. Table 1 lists the gate operations that occurred during the operation of the floodway in the spring of 2022. The floodway gates were initially bedded on April 15, ending the first period of operation. They were raised again on April 23 in response to rapidly increasing flows. This initiated the second period of operation. On June 16, after consultation with the City of Winnipeg, the floodway gates were transitioned out of service. Gate changes were no longer

having an observable impact on the river level at James Avenue by this time. The final gate operation occurred at 3:32 p.m. on June 16.

Figure 1 shows the recorded and natural water levels for the Red River in Winnipeg at James Avenue during the period of operation. Figure 2 shows the recorded and natural water levels for the Red River upstream of the floodway entrance.

4.2 Public Communication in 2022 Flood

During the 2022 flood, public communication was achieved by direct email to stakeholders, the publication of gate change notices and water level plots on Manitoba Transportation and Infrastructure's website, and through updates to the floodway operations info line.

MTI maintains an email database in accordance with the recommendations of the 2010 Public Review of the Red River Floodway Rules of Operation. The database includes municipal staff from the City of Winnipeg, Town of Morris, R.M. of Morris, R.M. of West St. Paul, City of Selkirk, R.M. of St. Clements, R.M. of St. Andrews, R.M. of Springfield, R.M. of MacDonald, and R.M. of Ritchot. Email notifications were distributed after each gate change operation. The first email was distributed April 4 at 3:20 p.m., providing notice of conditions at the floodway inlet, advising that flow had begun to enter the floodway naturally, but that ice was present in the river and was preventing initial operation of the floodway. A conditions update was sent out April 6, indicating that floodway operation was expected within days. A third notification was sent on April 7 indicating that ice had started to run through the control structure, and that initial operation would commence the following day. The initial operation notification was sent April 8 at 10:10 a.m. indicating that the gates had been raised. The final operation notification email was distributed on June 16 at 3:30 p.m., informing stakeholders on the contact list that floodway operations were complete for the spring 2022 flood.

Prior to the initial operation of the floodway, Manitoba Transportation and Infrastructure (MTI) hosted an annual pre-flood meeting of the Red River Floodway Operation Advisory Board.

MTI published the Red River Floodway gate change logs and hydrographs to the floodway information website (www.manitoba.ca/mit/wms/rrf/information.html). The hydrographs showed natural and observed water levels at the floodway inlet, flow in the Red River upstream of the inlet, and flow in the floodway. These plots were updated on a daily basis during the operating period. The gate change logs were updated as gate changes were made.

An information phone line (204-284-4550) was also maintained with the most recent information on the operation of the Red River Floodway.

4.3 Ice Conditions in 2022

Ice was intact on the Red River immediately upstream of the floodway inlet until April 7. Ice delayed floodway operations in 2022 by approximately 3 days. Flow had begun to enter the Floodway naturally on April 4, and by April 8 the level at James Avenue had risen above 16.5 ft

(5.03 m). North of Winnipeg, minor ice jams caused some temporary road closures and overland flooding. Drone footage was used to evaluate ice jam activity north of the City of Winnipeg.

Ice jamming was not a major issue along the Assiniboine River upstream of the Portage Diversion. The Portage Diversion was operated from April 6 to June 25. Initial operation, until May 15, was to maintain flows on the Lower Assiniboine to less than 5,000 cfs (141.6 cms) to mitigate the risk of Ice jamming. After May 15 the Portage Diversion was used to maintain water levels in Winnipeg at or below 19.0 ft.

4.4 Assiniboine River Flow Contribution

The Assiniboine River flows during the spring flood of 2022 were above average for the spring freshet. The computed peak natural Assiniboine flow at Portage la Prairie was 18,400 cfs (521.2 m³/s) on May 25. Due to significant precipitation driven local inflows downstream of the Portage Diversion, the natural Assiniboine River contribution at James Avenue peaked at 21,900 cfs (620.6 m³/s). The recorded flow along the Assiniboine River at Headingley reached a maximum of 11,000 cfs (312.3 m³/s) due to the operation of the Shellmouth Dam and Portage Diversion.

The greatest reduction in flow at James Avenue due to Shellmouth Dam operations occurred on May 16, when the Red River flow at James Avenue was reduced by approximately 1,990 cfs (56.4 m³/s).

The flow at the Portage Diversion peaked on May 3, at 11,480 cfs (325.1 m³/s). Combined with the impacts of the Shellmouth Dam, this resulted in a reduction in peak flow contribution to the Red River of 12,220 cfs (346.0 m³/s). Shellmouth Reservoir was only contributing a net reduction benefit of 770 cfs (21.8 m³/s) at Winnipeg during peak Portage Diversion Operation.

4.5 Floodway Maintenance and Efficiency

The floodway channel is maintaining acceptable levels of efficiency due to annual brush clearing in the floodway channel by Manitoba Infrastructure and Transportation regional maintenance staff. In 2022 the floodway showed increased efficiency of an additional 4% when compared to the previous rating curve.

5.0 CONCLUSIONS

In summary:

- During the spring of 2022, the Red River Floodway was operated for 61 days over two operating periods. In combination with other related flood control infrastructure such as the Portage Diversion and Shellmouth Reservoir, the flood crest in the City of Winnipeg was reduced by 9.51 ft (2.90 m) during the peak natural flow. The recorded peak water level at James Avenue was 18.99 ft (5.79 m).
- The first operation of the Red River Floodway began at 9:44 am on April 8, and concluded at 3:10 p.m. on April 15. The second operation of the Red River Floodway began at 3:48 pm on

April 23, and concluded at 3:32 p.m. on June 16. Over the course of the spring operation, 153 discrete gate adjustments were made as required.

- Recorded water levels upstream of the inlet were maintained below natural levels through the crest of the spring 2022 flood. However, it did exceed natural for brief periods of time during intense storm activity. These exceedances occurred during a rapidly rising limb, and did not impact the flood crest observed upstream of the floodway. On average, water levels were 0.40 ft (0.12 m) lower than natural levels during operation.
- The crest at the floodway inlet was 764.74 ft (233.09 m), 0.31 ft (0.10 m) lower than the computed natural level of 765.05 ft (233.19 m).
- Ice break-up delayed floodway operations by three days in 2022. Rising river levels within the City became concerning, but ultimately the ice broke up in time to avoid significant impacts. Minor ice jamming occurred north of the City of Winnipeg, resulting in road closures and overland flooding. The majority of overland flooding north of the City was due to heavy rains.
- During the spring of 2022, approximately 3.32 million acre-feet (4093 million m³) of water was diverted around the City of Winnipeg by the Red River Floodway, with a peak flow of 43,200 cfs (1223.2 m³/s).

Table 1 - 2022 Floodway Gate Operations**First Operation**

Date *	Upstream Water Level		Gate Elevation	
	(ft)	(m)	(ft)	(m)
Storage Position	748.65	228.19	728.04	221.91
2022-04-08 9:44 AM	753.38	229.63	737.09	224.67
2022-04-08 10:41 PM	754.40	229.94	738.62	225.13
2022-04-09 7:40 AM	755.09	230.15	740.05	225.57
2022-04-09 11:24 AM	755.22	230.19	741.48	226.00
2022-04-09 11:22 PM	755.38	230.24	741.10	225.89
2022-04-10 3:16 PM	755.41	230.25	741.39	225.98
2022-04-11 12:21 PM	755.18	230.18	741.67	226.06
2022-04-11 10:35 PM	755.12	230.16	741.96	226.15
2022-04-12 11:38 AM	755.02	230.13	741.58	226.03
2022-04-12 10:50 PM	754.66	230.02	741.00	225.86
2022-04-13 8:03 AM	754.30	229.91	740.43	225.68
2022-04-13 12:10 PM	754.07	229.84	739.95	225.54
2022-04-13 4:11 PM	753.87	229.78	739.19	225.31
2022-04-13 11:06 PM	753.41	229.64	736.52	224.49
2022-04-14 7:43 AM	752.59	229.39	735.58	224.20
2022-04-14 11:20 AM	752.17	229.26	734.83	223.98
2022-04-14 3:15 PM	752.00	229.21	734.08	223.75
2022-04-14 7:14 PM	751.64	229.10	733.34	223.52
2022-04-14 11:28 PM	751.64	229.10	731.88	223.08
2022-04-15 8:09 AM	751.25	228.98	730.62	222.69
2022-04-15 3:10 PM	750.39	228.72	728.04	221.91

*Time at start of gate operation

Second Operation

Date *	Upstream Water Level		Gate Elevation	
	(ft)	(m)	(ft)	(m)
Storage Position	748.65	228.19	728.04	221.91
2022-04-23 3:48 PM	751.02	228.91	738.04	224.95
2022-04-23 7:01 PM	751.61	229.09	741.58	226.03
2022-04-23 10:03 PM	752.82	229.46	745.62	227.26
2022-04-24 1:11 AM	754.82	230.07	747.45	227.82
2022-04-24 3:20 PM	757.25	230.81	746.45	227.52
2022-04-24 7:46 PM	757.71	230.95	746.73	227.60
2022-04-24 11:28 PM	758.07	231.06	747.00	227.69
2022-04-25 2:27 PM	758.63	231.23	746.54	227.55
2022-04-26 6:56 AM	758.99	231.34	746.73	227.60
2022-04-26 2:55 PM	759.12	231.38	747.00	227.69
2022-04-26 7:20 PM	759.25	231.42	747.36	227.80
2022-04-26 11:10 PM	759.48	231.49	748.26	228.07
2022-04-27 7:18 AM	759.97	231.64	748.62	228.18
2022-04-27 2:36 PM	760.24	231.72	749.24	228.37
2022-04-27 10:14 PM	760.53	231.81	749.77	228.53
2022-04-28 7:18 AM	760.86	231.91	750.38	228.72

Table 1 Continued - 2022 Floodway Gate Operations

Date *	Upstream Water Level		Gate Elevation	
	(ft)	(m)	(ft)	(m)
2022-04-29 4:00 PM	761.19	232.01	750.63	228.79
2022-04-28 7:56 PM	761.29	232.04	751.23	228.97
2022-04-29 7:19 AM	761.61	232.14	750.72	228.82
2022-04-29 11:44 AM	761.55	232.12	750.12	228.64
2022-04-29 10:44 PM	761.35	232.06	750.38	228.72
2022-04-30 7:27 AM	761.48	232.10	750.81	228.85
2022-04-30 11:12 AM	761.65	232.15	751.48	229.05
2022-04-30 3:25 PM	761.94	232.24	751.82	229.15
2022-04-30 10:22 PM	762.34	232.36	752.65	229.41
2022-05-01 3:11 AM	762.70	232.47	753.14	229.56
2022-05-01 7:22 AM	762.96	232.55	753.38	229.63
2022-05-01 3:10 PM	763.29	232.65	753.22	229.58
2022-05-02 3:14 PM	763.68	232.77	752.98	229.51
2022-05-03 7:47 PM	763.91	232.84	752.81	229.46
2022-05-04 10:35 PM	764.01	232.87	752.57	229.38
2022-05-05 7:04 PM	764.01	232.87	752.24	229.28
2022-05-05 11:00 PM	763.98	232.86	752.07	229.23
2022-05-07 10:07 AM	764.01	232.87	751.73	229.13
2022-05-07 2:20 PM	763.94	232.85	751.57	229.08
2022-05-09 2:58 PM	764.07	232.89	751.90	229.18
2022-05-09 7:20 PM	764.14	232.91	752.24	229.28
2022-05-10 10:54 AM	764.34	232.97	752.07	229.23
2022-05-13 11:01 PM	764.47	233.01	751.73	229.13
2022-05-14 10:56 PM	764.40	232.99	751.57	229.08
2022-05-16 10:55 PM	764.21	232.93	751.40	229.03
2022-05-17 10:47 AM	764.14	232.91	751.23	228.97
2022-05-18 10:57 AM	763.98	232.86	751.40	229.03
2022-05-18 3:04 PM	764.04	232.88	751.57	229.08
2022-05-18 10:41 PM	764.04	232.88	751.40	229.03
2022-05-19 7:17 AM	763.94	232.85	751.14	228.95
2022-05-19 10:53 PM	763.88	232.83	751.48	229.05
2022-05-20 3:13 AM	763.94	232.85	751.90	229.18
2022-05-20 7:11 AM	764.04	232.88	752.15	229.26
2022-05-20 6:08 PM	764.14	232.91	751.90	229.18
2022-05-20 10:29 PM	764.11	232.90	751.65	229.10
2022-05-22 10:11 PM	763.94	232.85	751.48	229.05
2022-05-23 3:09 PM	763.81	232.81	751.31	229.00
2022-05-23 10:44 PM	763.71	232.78	751.06	228.92
2022-05-24 3:34 PM	763.55	232.73	750.81	228.85
2022-05-24 7:11 PM	763.45	232.70	750.55	228.77
2022-05-24 11:00 PM	763.32	232.66	750.20	228.66
2022-05-26 11:17 AM	762.83	232.51	749.94	228.58
2022-05-26 10:01 PM	762.63	232.45	749.68	228.50
2022-05-27 11:49 AM	762.37	232.37	749.50	228.45
2022-05-27 4:09 PM	762.27	232.34	749.24	228.37
2022-05-27 10:09 PM	762.11	232.29	748.98	228.29
2022-05-28 3:06 PM	761.75	232.18	748.80	228.23
2022-05-28 10:08 PM	761.61	232.14	748.44	228.12
2022-05-29 8:30 AM	761.32	232.05	748.17	228.04
2022-05-30 9:12 PM	760.76	231.88	748.44	228.12
2022-05-31 2:20 AM	760.83	231.90	749.15	228.34
2022-05-31 7:12 AM	761.19	232.01	749.59	228.48

Table 1 Continued - 2022 Floodway Gate Operations

Date *	Upstream Water Level		Gate Elevation	
	(ft)	(m)	(ft)	(m)
2022-05-31 11:25 AM	761.38	232.07	749.94	228.58
2022-05-31 3:01 PM	761.48	232.10	750.20	228.66
2022-05-31 10:29 PM	761.68	232.16	750.46	228.74
2022-06-01 1:45 PM	761.78	232.19	750.20	228.66
2022-06-01 10:23 PM	761.71	232.17	749.94	228.58
2022-06-02 7:17 AM	761.58	232.13	749.77	228.53
2022-06-02 11:00 AM	761.52	232.11	749.59	228.48
2022-06-02 10:20 PM	761.32	232.05	749.33	228.40
2022-06-03 7:21 AM	761.12	231.99	749.15	228.34
2022-06-03 11:28 AM	761.02	231.96	748.80	228.23
2022-06-03 3:03 PM	760.89	231.92	748.53	228.15
2022-06-03 7:20 PM	760.73	231.87	748.35	228.10
2022-06-03 11:12 PM	760.60	231.83	747.99	227.99
2022-06-04 7:59 AM	760.27	231.73	747.81	227.93
2022-06-04 11:49 AM	760.14	231.69	747.54	227.85
2022-06-04 3:38 PM	759.97	231.64	747.36	227.80
2022-06-04 7:05 PM	759.84	231.60	747.09	227.71
2022-06-04 11:02 PM	759.68	231.55	746.63	227.57
2022-06-05 9:57 AM	759.25	231.42	746.45	227.52
2022-06-05 1:18 PM	759.12	231.38	745.99	227.38
2022-06-05 6:07 PM	758.86	231.30	745.44	227.21
2022-06-05 10:38 PM	758.53	231.20	744.78	227.01
2022-06-06 11:10 AM	757.94	231.02	744.50	226.92
2022-06-06 3:12 PM	757.71	230.95	744.22	226.84
2022-06-06 7:13 PM	757.51	230.89	743.85	226.73
2022-06-06 11:27 PM	757.28	230.82	743.38	226.58
2022-06-07 10:55 AM	756.79	230.67	743.19	226.52
2022-06-07 3:11 PM	756.63	230.62	742.90	226.44
2022-06-07 7:14 PM	756.43	230.56	742.53	226.32
2022-06-07 11:15 PM	756.23	230.50	742.05	226.18
2022-06-08 11:00 AM	755.71	230.34	741.86	226.12
2022-06-08 3:00 PM	755.54	230.29	741.67	226.06
2022-06-08 6:58 PM	755.41	230.25	741.29	225.95
2022-06-08 10:49 PM	755.22	230.19	740.91	225.83
2022-06-09 11:06 AM	754.79	230.06	740.72	225.77
2022-06-09 3:05 PM	754.59	230.00	740.53	225.71
2022-06-09 7:06 PM	754.49	229.97	740.14	225.59
2022-06-09 10:51 PM	754.30	229.91	739.76	225.48
2022-06-10 10:57 AM	753.94	229.80	739.48	225.39
2022-06-10 3:02 PM	753.77	229.75	739.09	225.27
2022-06-10 7:32 PM	753.58	229.69	738.71	225.16
2022-06-10 11:34 PM	753.38	229.63	738.33	225.04
2022-06-11 11:10 AM	753.08	229.54	738.14	224.99
2022-06-11 11:10 AM	753.08	229.54	738.14	224.99
2022-06-11 3:00 PM	752.92	229.49	737.85	224.90
2022-06-11 7:08 PM	752.79	229.45	737.57	224.81
2022-06-11 11:15 PM	752.66	229.41	737.28	224.72
2022-06-12 7:03 PM	752.36	229.32	737.00	224.64
2022-06-12 10:58 PM	752.30	229.30	736.43	224.46
2022-06-13 7:21 AM	752.07	229.23	735.95	224.32
2022-06-13 11:15 AM	751.94	229.19	735.58	224.20
2022-06-13 7:08 PM	751.71	229.12	735.39	224.15

Table 1 Continued - 2022 Floodway Gate Operations

Date *	Upstream Water Level		Gate Elevation	
	(ft)	(m)	(ft)	(m)
2022-06-13 11:02 PM	751.64	229.10	735.01	224.03
2022-06-14 11:05 AM	751.41	229.03	734.64	223.92
2022-06-14 6:55 PM	751.35	229.01	734.36	223.83
2022-06-14 11:06 PM	751.28	228.99	733.71	223.63
2022-06-15 7:16 AM	751.08	228.93	733.06	223.44
2022-06-15 11:02 AM	750.98	228.90	732.42	223.24
2022-06-15 3:24 PM	750.82	228.85	731.88	223.08
2022-06-15 7:10 PM	750.72	228.82	731.51	222.96
2022-06-15 11:11 PM	750.66	228.80	731.25	222.89
2022-06-16 7:35 AM	750.59	228.78	731.07	222.83
2022-06-16 11:06 AM	750.49	228.75	730.62	222.69
2022-06-16 3:32 PM	750.39	228.72	728.04	221.91

Figure 1 - Recorded and Natural Levels at James Avenue 2022

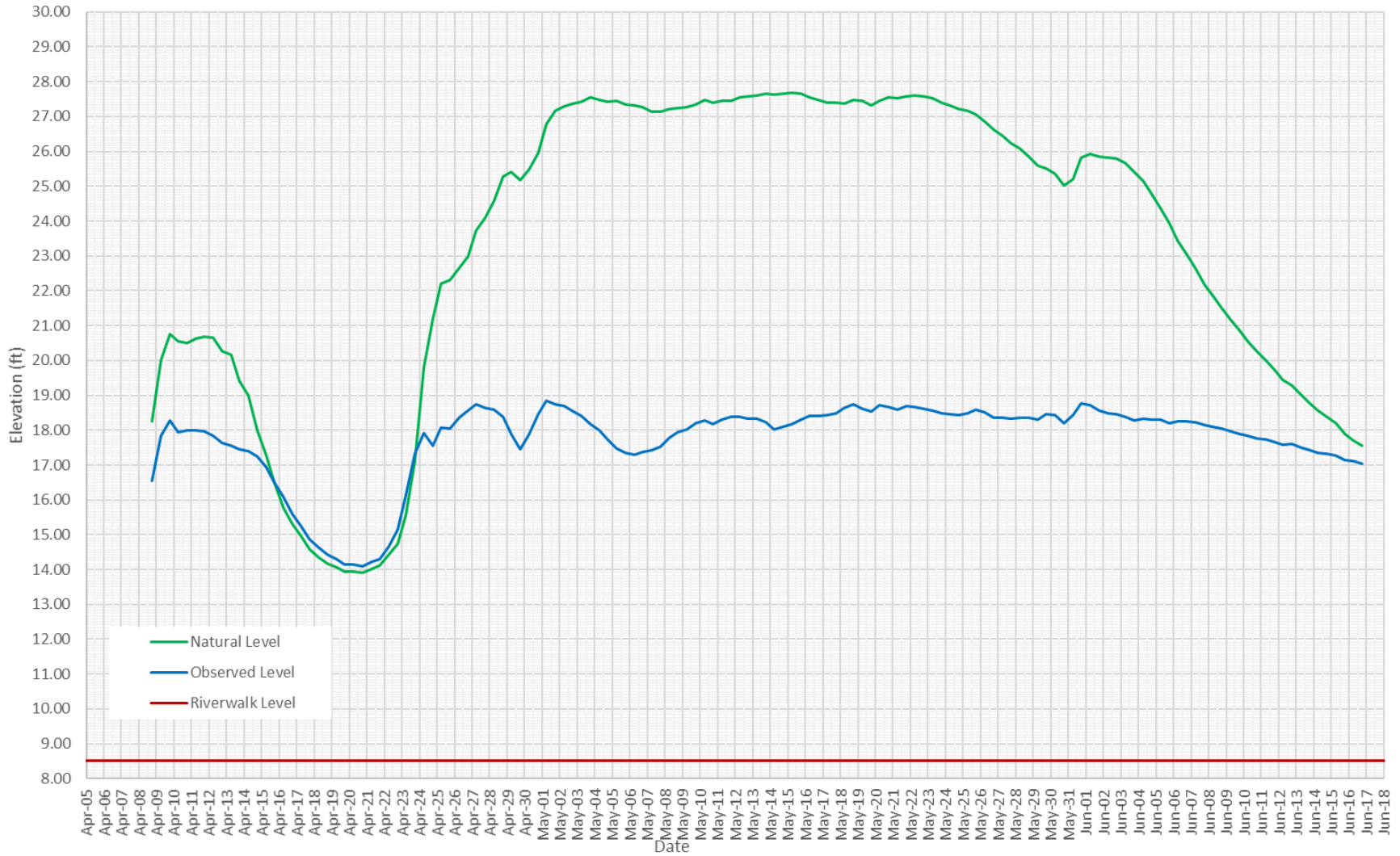
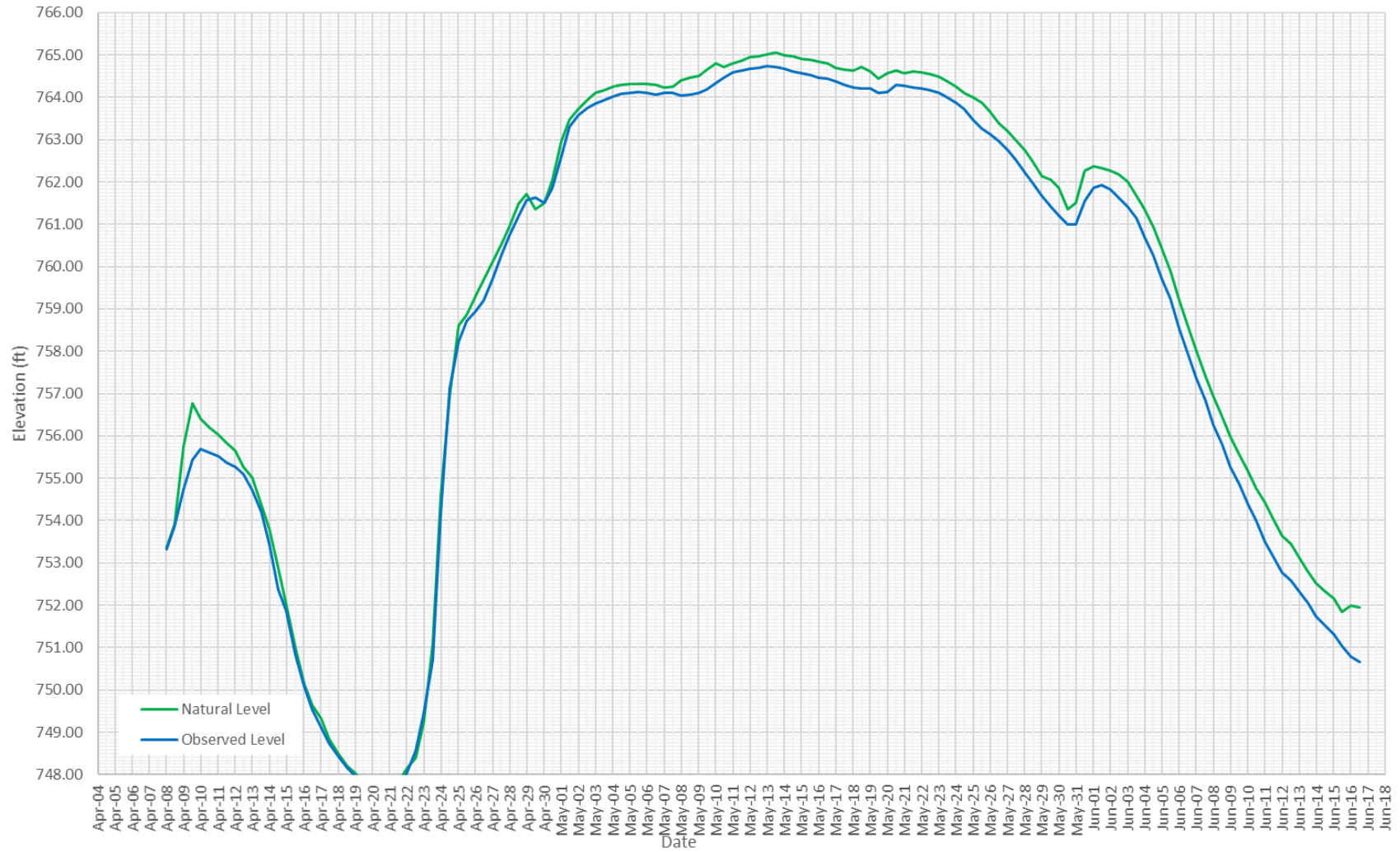


Figure 2 - Recorded and Natural Levels at Floodway Entrance 2022



APPENDIX A

Red River Floodway Rules of Operation

Rules of Operation

Red River Floodway Control Structure

Normal Operation:

1. Maintain natural¹ water levels on the Red River at the entrance to the floodway channel, until the water surface elevation at James Avenue reaches 24.5 ft (7.46 m), or the river level anywhere along the Red River within the City of Winnipeg reaches two feet below the Flood Protection Level of 27.83 ft (8.48 m).

Major Flood Operation:

2. Once the river levels within Winnipeg reach the limits described in Rule 1, the level in Winnipeg should be held constant while levels south of the control structure continue to rise. Furthermore, if forecasts indicate that levels at the entrance to the floodway channel will rise more than two feet (0.6 m) above natural, the City of Winnipeg must proceed with emergency raising of the dikes and temporary protection measures on the sewer systems in accordance with the flood level forecasts within Winnipeg. The levels in Winnipeg should be permitted to rise as construction proceeds, but not so as to encroach on the freeboard of the dikes or compromise the emergency measures undertaken for protecting the sewer systems. At the same time, the Province should consider the possibility of an emergency increase in the height of the floodway embankments and the West Dike. At no time will the water level at the floodway channel's entrance be allowed to rise to a level that infringes on the allowable freeboard on the floodway west embankment (Winnipeg side) and the West Dike.

Extreme Flood Operation:

3. For extreme floods, where the water level at the floodway channel's entrance reaches the maximum level that can be held by the floodway west embankment and the West Dike, the river level must not be permitted to exceed that level. All additional flows must be passed through Winnipeg.

Initial Gate Operation with Ice:

The floodway gates should not be operated until ice on the river is flowing freely, unless flooding in Winnipeg is imminent.

Final Drop of Gates:

To minimize bank slumping along the river in Winnipeg and at the same time reduce the probability of sewer backup problems, final gate operations, once the level at the entrance to the floodway channel recedes to elevation 752 ft (229 m), shall be carried out in consultation with the City of Winnipeg.

Emergency Operation to Reduce Sewer Backup in Winnipeg

4(1) This rule defines the circumstances under which the Minister of Manitoba Infrastructure ("the Minister") may determine that emergency operation of the floodway is necessary to prevent widespread basement flooding and resulting risk to health and damage to property within the City of Winnipeg.

4(2) This rule applies after the spring crest from snowmelt runoff at Winnipeg, whenever high river levels substantially impair the capacity of Winnipeg's combined sewer system.

4(3) As long as the Department of Manitoba Infrastructure ("the Department") forecasts that river levels for the next 10 days will be below 14 ft James Avenue Pumping Station Datum (JAPSD), the Department will not operate the floodway control structure.

¹ The term natural refers to the level that would have occurred in the absence of the flood control works, with the level of urban development in place at the time of the construction of these works.

4(4) When the Department forecasts that river levels for the next 10 days are expected to rise to 14 feet JAPSD or higher, the Department will prepare a report that describes:

- (a) The basis of the Department's river level forecasts and its risk assessment;
- (b) The risk of basement flooding in Winnipeg, including the following factors:
 - (i) The predicted peak river level in the next 10 days;
 - (ii) The length of time the Department forecasts the river level will be at 14 ft JAPSD or higher;
 - (iii) The risk of an intense rainfall event in Winnipeg in the next 10 days;
- (c) The benefits and costs of floodway operation, including:
 - (i) The extent of basement flooding and damage to property expected from various combinations of intense rainfall events and high river levels;
 - (ii) The risk to the health of Winnipeg residents from sewer backup;
 - (iii) Economic loss and damage caused by artificial flooding south of the Inlet Control Structure;
 - (iv) Impacts of operation on fish and wildlife and their habitat and on water quality;
 - (v) The risks and potential costs of riverbank instability that may be caused by artificial river level changes, both upstream and downstream of the Inlet Control Structure;
 - (vi) During construction of the floodway expansion, costs and risks associated with any resulting delays of that construction, including the potential average annual expected damages associated with an additional period of risk of a flood event that would exceed the current capacity of the floodway;
 - (vii) Such other benefits and costs of operation of which the Department is aware at the time of the preparation of the report, excluding benefits associated with recreational or tourism activities or facilities; and
- (d) measures that may be taken to mitigate the costs and impacts of the operation under consideration, including:
 - (i) minimizing the rate at which river levels are changed both upstream and downstream of the floodway Inlet Control Structure;
 - (ii) providing means to assure fish passage.

4(5) The Department will present a draft of the report prepared under Rule 4(4) to the Floodway Operation Review Committee and provide an opportunity for the Committee to provide input, before finalizing the report and making recommendations respecting floodway operation.

4(6) The Department will not recommend operation of the floodway unless the expected benefits of doing so clearly and substantially outweigh the expected costs.

4(7) The Department will present its report and recommendations to the Minister, who, subject to Rule 4(8), will make a decision respecting floodway operation based on his or her consideration of the report.

4(8) The Department will not operate the floodway control structure under this rule:

(a) to raise river levels immediately upstream of the control structure to an elevation higher than 760 ft above sea level;

(b) to achieve a river level of less than 9 ft JAPSD; or

(c) except in circumstances of extreme urgency, to lower river levels more than one foot per day.

4(9) The Department will issue a news release announcing a decision to operate the floodway at least 24 hours before commencing operation.

4(10) The Department will ensure every reasonable effort is made to personally notify landowners who may be directly affected by flooding due to floodway operation in advance of the operation.

4(11) The Department will sound the horn at the floodway Inlet Control Structure one-half hour before operation commences.

4(12) The Department will maintain a program of compensation for damages suffered by landowners arising from flooding caused by floodway operation under this rule.

APPENDIX B

Computation of Natural Flows and Levels

Computation of Natural Flows and Levels On the Red and Assiniboine Rivers

Figure 1 and Figure 2 in the main report show the natural and observed levels at the floodway inlet and James Avenue. This Appendix describes how these levels were determined, and explains how the relationships developed in the Acres 2004 study were applied to compute the natural level at the floodway entrance.

Table B-1 lists the recorded and computed flows and levels for each time step. Columns 1 to 7 list the flows used in computing the natural flows on the Assiniboine River, and columns 8 to 10 list the flows used for computing the natural flows on the Red River.

Natural Assiniboine River Flow

The natural (unregulated) flows on the Assiniboine River are altered by operation of the Shellmouth Dam, the Portage Diversion, and by the presence of dikes along the Assiniboine River.

The Shellmouth Dam can decrease flows below natural levels by adjusting the control gates so that reservoir outflows are lower than inflows. In this case, the reservoir levels rise, and excess water is stored behind the dam.

The Portage Diversion can be used to reduce flows in the lower Assiniboine River by diverting some of the river flow north to Lake Manitoba.

The Assiniboine River dikes were constructed to prevent overflows from the river onto the surrounding lands. Much of this overflow would not return to the Assiniboine River because of the height of the river and the slope of the land. Therefore, the dikes have the effect of increasing flows entering Winnipeg on the Assiniboine River during periods of high flow.

Referring to Table B-1, column 1 lists the flow reductions at Winnipeg resulting from storage behind the Shellmouth Dam. It is important to recognize that these flow changes at the dam take some time to reach Winnipeg. The department uses the Muskingum routing procedure to compute this flow attenuation.

Column 2 shows the flows diverted to Lake Manitoba via the Portage Diversion. Again the flows are routed to Winnipeg to apply the time delay.

Column 3 shows the recorded flows at the hydrometric station at Headingley.

Column 4 lists the computed breakouts that would have occurred at those flows if the dikes had not been constructed.

Column 5 lists the computed natural flows at Headingley. These are computed by adding the values in columns 1 to 3 (Shellmouth flow reduction, recorded Portage Diversion flow, and recorded Headingley flow) and subtracting by the computed Assiniboine River natural breakouts.

There is some additional local inflow entering the Assiniboine River between Headingley and the Forks. Most of this flow is recorded on Sturgeon Creek. However, in column 6 the recorded flows on Sturgeon Creek are increased to include the estimated unmeasured local inflows.

Finally columns 5 and 6 are added together to give the computed natural flows of the Assiniboine River at the Forks, as listed in column 7.

Natural Red River Flow

On the Red River the primary flow adjustment is caused by the Red River Floodway. During periods of extensive flooding there can also be a flow change resulting from changes in the storage of floodwaters on the land, but as long as flood levels at the floodway entrance are held at natural that change would be negligible.

Column 8 lists the recorded flows in the floodway channel, and column 9 shows the recorded flows at James Avenue. Column 10 sums the flows in columns 1, 2, 8 and 9, and subtracts column 4 to give the total natural flow on the Red River at James Avenue, which is downstream of the Forks.

Natural River Levels at the Floodway Inlet

Table B-2 is a reproduction of Table 4-7 from the Acres report "*Re-Computation of Natural Water Levels at the Floodway Inlet (Final Report), April 2004.*" The table provides natural elevations at the inlet based upon the relative contribution of natural flow at the Forks from the Red and Assiniboine Rivers. The *combined* flow is represented by the values in the left-hand column entitled Natural Red River at James Avenue Flow. The Natural Assiniboine River Flow Contribution amount is shown across the top and is the flow in the Assiniboine River at the Forks.

The natural water level at the inlet can vary by a few feet dependent upon the amount of flow coming from the Assiniboine River (Assiniboine River Contribution). This phenomenon is referred to as a variable backwater effect.

This concept can be illustrated by using the example of 100,000 cfs flow for the Red River at James Avenue in various combinations of Red and Assiniboine river flows. One combination could have 95,000 cfs as Red River flow upstream of the Forks, and 5,000 cfs as the Assiniboine River Contribution. This combination results in a level at the inlet of 765.6 ft as shown in Table B-2. Similarly, another combination, while still yielding a total James Avenue flow of 100,000 cfs, could be 70,000 cfs as the Red River flow upstream of the Forks, and 30,000 cfs as the Assiniboine River Contribution. The resulting inlet level would be 762.9 ft (232.53 m). The difference in the inlet water elevation between these two flow combinations is 2.7 ft (0.82 m), with the lower elevation occurring when there is relatively more flow on the Assiniboine River.

Natural water levels are determined by using the natural Red River flows at James Avenue listed in column 10 of Table B-1, and the natural Assiniboine River flows listed in column 7 of Table B-1, and interpolating between the values listed in Table B-2 to determine the natural levels. These natural levels are listed in column 13 of Table B-1. For comparison, column 14 of Table B-1 lists the recorded levels at the floodway inlet (station 05OC026). Similar levels for James Avenue in Winnipeg are provided in columns 11 and 12.

Table B-1 - Spring 2022 Flows and Levels

Column =>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Date	Assiniboine River							Red River									
	Shellmouth Flow Reduction (Routed to Headingley) Recorded	Portage Diversion flow (Routed to Headingley) Recorded	Actual Assiniboine R. flow at Headingley Recorded	Natural breakouts from river Computed	Natural Assiniboine River flow at Headingley =1+2+3-4	Sturgeon Cr. Flow plus other local inflows Rec. & Est.	Natural Assiniboine R. flow into Red River =5+6	Red River flow U/S of Floodway Computed	Red River Floodway flow Recorded	La Salle flow Recorded	Red River flow at James Ave. Recorded	Natural Red River flow at James Avenue =1+2-4+9+10	Natural water level on Red R. At James Ave (feet) Computed	Recorded Water level on Red R. at James Ave (feet) Recorded	Natural water level on Red R. at Floodway Inlet (feet) Computed	Recorded Water level on Red R. at Floodway Inlet (feet) Recorded	Below Natural at Floodway Inlet (feet) Computed
April 8, 2022 AM	-922	0	5,821	211	4,689	436	5,335	43,743	5,467	885	45,418	49,718	17.49	16.39	753.36	753.31	0.04
April 8, 2022 PM	-909	81	5,740	337	4,575	486	5,398	46,697	7,984	1,071	46,010	52,829	18.26	16.55	753.91	753.88	0.03
April 9, 2022 AM	-898	261	6,069	456	4,976	573	6,004	53,442	10,339	1,301	51,046	60,292	20.00	17.83	755.76	754.75	1.02
April 9, 2022 PM	-875	268	6,163	546	5,009	578	6,132	56,554	12,022	1,595	52,867	63,736	20.75	18.29	756.77	755.44	1.33
April 10, 2022 AM	-858	269	6,626	588	5,449	662	6,699	54,870	12,638	1,850	51,370	62,831	20.56	17.93	756.40	755.70	0.70
April 10, 2022 PM	-823	410	6,957	646	5,898	857	7,401	53,665	11,987	2,143	51,635	62,563	20.50	17.99	756.19	755.61	0.57
April 11, 2022 AM	-800	1,156	7,443	688	7,111	1,345	9,144	52,276	11,801	2,417	51,681	63,150	20.63	18.00	756.04	755.51	0.53
April 11, 2022 PM	-753	1,850	7,675	746	8,025	1,775	10,546	50,888	11,499	2,678	51,516	63,366	20.67	17.96	755.85	755.37	0.48
April 12, 2022 AM	-725	2,489	7,915	784	8,895	1,907	11,586	49,634	11,262	2,868	51,062	63,305	20.66	17.85	755.64	755.26	0.38
April 12, 2022 PM	-667	2,054	7,929	800	8,515	1,263	10,578	48,667	10,725	3,069	50,203	61,514	20.27	17.64	755.27	755.10	0.16
April 13, 2022 AM	-635	2,728	7,820	800	9,112	1,205	11,118	47,554	9,815	3,135	49,898	61,006	20.15	17.55	755.01	754.73	0.29
April 13, 2022 PM	-571	1,250	7,420	800	7,300	885	8,985	46,325	8,344	3,204	49,489	57,713	19.42	17.45	754.37	754.21	0.16
April 14, 2022 AM	-536	1,909	6,971	800	7,543	716	9,059	44,677	6,036	3,054	49,382	55,990	19.01	17.41	753.81	753.45	0.37
April 14, 2022 PM	-468	287	6,472	800	5,491	625	6,916	42,818	3,931	2,802	48,786	51,736	17.99	17.25	752.87	752.37	0.50
April 15, 2022 AM	-434	265	6,029	800	5,060	570	6,430	40,815	2,276	2,443	47,581	48,888	17.27	16.93	752.02	751.87	0.15
April 15, 2022 PM	-366	192	5,753	800	4,780	546	6,126	38,444	1,010	2,145	45,878	45,915	16.50	16.49	751.03	750.84	0.19
April 16, 2022 AM	-332	71	5,539	800	4,478	543	5,821	36,460	0	1,761	44,303	43,241	15.78	16.07	750.15	750.08	0.07
April 16, 2022 PM	-265	36	4,945	800	3,915	558	5,273	35,559	0	1,441	42,504	41,474	15.30	15.58	749.65	749.53	0.12
April 17, 2022 AM	-233	0	4,330	800	3,297	544	4,641	35,200	0	1,124	41,198	40,165	14.95	15.23	749.34	749.13	0.21
April 17, 2022 PM	-169	1	4,262	800	3,294	546	4,640	34,084	0	949	39,840	38,873	14.59	14.86	748.84	748.73	0.11
April 18, 2022 AM	-137	0	4,300	800	3,363	549	4,712	33,348	0	813	39,009	38,072	14.36	14.63	748.50	748.45	0.05
April 18, 2022 PM	-73	0	4,307	800	3,434	551	4,786	32,710	0	712	38,280	37,407	14.17	14.42	748.22	748.17	0.04
April 19, 2022 AM	-40	0	4,370	800	3,530	546	4,876	32,357	0	566	37,839	37,000	14.06	14.30	748.03	747.97	0.06
April 19, 2022 PM	27	0	4,503	800	3,729	549	5,078	31,778	0	492	37,321	36,547	13.93	14.15	747.80	747.79	0.01
April 20, 2022 AM	62	0	4,619	804	3,877	556	5,237	31,748	0	384	37,307	36,565	13.94	14.15	747.77	747.69	0.08
April 20, 2022 PM	133	0	4,734	846	4,022	568	5,435	31,498	0	350	37,150	36,438	13.90	14.10	747.67	747.61	0.06
April 21, 2022 AM	172	0	4,860	888	4,144	658	5,690	31,732	0	345	37,595	36,879	14.02	14.23	747.78	747.64	0.14
April 21, 2022 PM	249	0	5,062	946	4,366	767	6,078	31,578	0	484	37,890	37,194	14.11	14.31	747.81	747.73	0.08

Column =>		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Date		Assiniboine River							Red River									
		Shellmouth Flow Reduction (Routed to Headingley) Recorded	Portage Diversion flow (Routed to Headingley) Recorded	Actual Assiniboine R. flow at Headingley Recorded	Natural breakouts from river Computed	Natural Assiniboine River flow at Headingley =1+2+3-4	Sturgeon Cr. Flow plus other local inflows Rec. & Est.	Natural Assiniboine R. flow into Red River =5+6	Red River flow U/S of Floodway Computed	Red River Floodway flow Recorded	La Salle flow Recorded	Red River flow at James Ave. Recorded	Natural Red River flow at James Avenue =1+2-4+9+10	Natural water level on Red R. At James Ave (feet) Computed	Recorded Water level on Red R. at James Ave (feet) Recorded	Natural water level on Red R. at Floodway Inlet (feet) Computed	Recorded Water level on Red R. at Floodway Inlet (feet) Recorded	Below Natural at Floodway Inlet (feet) Computed
April 22, 2022	AM	290	0	5,382	1,057	4,616	1,004	6,676	31,977	0	759	39,122	38,356	14.44	14.66	748.13	748.03	0.11
April 22, 2022	PM	372	0	5,780	1,913	4,238	1,163	7,314	32,746	0	1,230	40,918	39,377	14.73	15.15	748.39	748.56	-0.17
April 23, 2022	AM	413	24	6,627	2,681	4,382	1,534	8,597	34,520	212	2,035	44,504	42,471	15.58	16.12	749.24	749.45	-0.21
April 23, 2022	PM	495	153	7,327	3,000	4,975	1,833	9,808	38,335	1,492	3,147	49,151	48,291	17.11	17.33	751.09	750.71	0.38
April 24, 2022	AM	533	746	7,979	2,964	6,294	2,388	11,646	45,481	8,568	4,662	51,943	60,039	19.79	17.93	754.59	754.16	0.43
April 24, 2022	PM	610	326	8,152	2,543	6,545	2,190	11,278	51,961	17,054	5,687	50,936	67,288	21.21	17.55	756.93	757.14	-0.21
April 25, 2022	AM	643	0	8,034	2,214	6,464	1,407	10,084	58,697	20,764	5,680	53,054	72,248	22.20	18.08	758.61	758.24	0.38
April 25, 2022	PM	710	0	7,842	2,685	5,867	801	9,354	60,770	21,846	5,283	52,851	72,722	22.30	18.04	758.87	758.72	0.15
April 26, 2022	AM	737	0	8,054	3,243	5,549	950	9,742	62,986	22,835	5,020	54,175	74,505	22.65	18.37	759.30	758.95	0.35
April 26, 2022	PM	792	277	8,364	3,272	6,161	975	10,408	64,257	23,470	4,848	54,975	76,242	22.98	18.56	759.68	759.20	0.48
April 27, 2022	AM	813	1,132	8,669	3,062	7,552	1,444	12,057	64,740	25,282	4,851	54,422	78,587	23.73	18.74	760.11	759.71	0.40
April 27, 2022	PM	854	1,478	9,160	2,772	8,720	1,405	12,897	65,673	27,064	4,775	53,949	80,574	24.10	18.64	760.53	760.28	0.25
April 28, 2022	AM	869	2,599	9,403	2,562	10,309	1,673	14,543	66,577	28,654	4,626	53,626	83,186	24.58	18.58	760.96	760.75	0.21
April 28, 2022	PM	897	5,854	9,430	2,275	13,907	1,703	17,882	67,102	29,902	4,444	52,778	87,157	25.28	18.38	761.47	761.18	0.29
April 29, 2022	AM	905	7,312	7,592	2,094	13,715	1,695	17,504	68,096	31,060	4,356	50,680	87,863	25.41	17.89	761.71	761.57	0.14
April 29, 2022	PM	920	7,693	6,792	2,183	13,223	1,977	17,382	66,856	31,067	4,353	48,911	86,409	25.17	17.45	761.35	761.63	-0.27
April 30, 2022	AM	920	8,372	7,740	2,347	14,686	2,722	19,741	66,482	30,683	4,397	50,658	88,288	25.48	17.88	761.49	761.50	-0.01
April 30, 2022	PM	921	7,084	9,125	2,392	14,739	3,423	20,516	68,161	32,350	4,671	53,029	90,993	25.95	18.47	762.05	761.87	0.18
May 1, 2022	AM	915	7,546	9,973	2,458	15,975	3,628	21,916	71,333	35,490	5,016	54,461	95,953	26.78	18.85	762.96	762.60	0.36
May 1, 2022	PM	902	7,493	10,101	2,420	16,076	3,515	21,846	73,309	38,238	5,268	53,955	98,168	27.15	18.75	763.47	763.30	0.17
May 2, 2022	AM	890	7,460	9,612	2,295	15,668	3,278	21,150	74,718	39,209	5,296	53,694	98,959	27.29	18.70	763.73	763.58	0.15
May 2, 2022	PM	868	7,954	8,738	2,118	15,442	2,871	20,377	75,903	39,781	5,296	53,028	99,513	27.38	18.55	763.94	763.75	0.19
May 3, 2022	AM	854	8,436	7,843	1,956	15,177	2,565	19,683	76,781	40,059	5,294	52,424	99,818	27.43	18.40	764.10	763.84	0.26
May 3, 2022	PM	827	9,899	7,150	1,950	15,926	2,318	20,053	77,042	40,310	5,251	51,451	100,537	27.54	18.17	764.17	763.94	0.23
May 4, 2022	AM	814	9,684	6,279	1,747	15,030	2,187	18,942	77,630	40,639	5,207	50,664	100,054	27.47	17.99	764.25	764.02	0.23
May 4, 2022	PM	790	10,103	5,195	1,609	14,480	2,058	18,146	78,068	40,779	5,123	49,666	99,729	27.42	17.74	764.30	764.08	0.22
May 5, 2022	AM	783	11,194	4,406	1,529	14,854	1,927	18,312	78,109	40,820	5,043	48,664	99,932	27.46	17.49	764.32	764.11	0.21
May 5, 2022	PM	768	11,024	3,711	1,500	14,004	1,814	17,317	78,436	40,820	4,969	48,110	99,223	27.35	17.35	764.30	764.13	0.18

Column =>		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		Assiniboine River							Red River									
Date		Shellmouth Flow Reduction (Routed to Headingley) Recorded	Portage Diversion flow (Routed to Headingley) Recorded	Actual Assiniboine R. flow at Headingley Recorded	Natural breakouts from river Computed	Natural Assiniboine River flow at Headingley =1+2+3-4	Sturgeon Cr. Flow plus other local inflows Rec. & Est.	Natural Assiniboine R. flow into Red River =5+6	Red River flow U/S of Floodway Computed	Red River Floodway flow Recorded	La Salle flow Recorded	Red River flow at James Ave. Recorded	Natural Red River flow at James Avenue =1+2-4+9+10	Natural water level on Red R. At James Ave (feet) Computed	Recorded Water level on Red R. at James Ave (feet) Recorded	Natural water level on Red R. at Floodway Inlet (feet) Computed	Recorded Water level on Red R. at Floodway Inlet (feet) Recorded	Below Natural at Floodway Inlet (feet) Computed
May 6, 2022	AM	769	11,148	3,353	1,496	13,773	1,716	16,986	78,680	40,696	4,876	47,929	99,046	27.32	17.30	764.31	764.10	0.22
May 6, 2022	PM	770	10,629	3,466	1,454	13,411	1,668	16,533	78,831	40,521	4,781	48,225	98,691	27.26	17.37	764.30	764.07	0.23
May 7, 2022	AM	780	9,593	3,916	1,412	12,877	1,604	15,894	78,846	40,663	4,680	48,383	98,008	27.15	17.42	764.24	764.10	0.14
May 7, 2022	PM	801	8,948	4,300	1,354	12,695	1,523	15,572	79,064	40,678	4,588	48,797	97,870	27.13	17.52	764.25	764.10	0.15
May 8, 2022	AM	823	8,489	4,623	1,312	12,622	1,379	15,313	79,913	40,484	4,475	49,904	98,388	27.21	17.80	764.40	764.05	0.35
May 8, 2022	PM	865	7,923	4,915	1,254	12,449	1,384	15,088	80,319	40,474	4,364	50,509	98,516	27.23	17.95	764.46	764.06	0.39
May 9, 2022	AM	899	7,624	5,291	1,212	12,602	1,344	15,158	80,559	40,669	4,243	50,767	98,748	27.27	18.01	764.50	764.10	0.41
May 9, 2022	PM	967	6,923	5,731	1,154	12,466	1,230	14,851	81,465	40,985	4,134	51,574	99,295	27.36	18.21	764.65	764.18	0.47
May 10, 2022	AM	1,014	6,467	6,333	1,112	12,702	1,100	14,914	82,223	41,856	4,027	51,827	100,052	27.49	18.28	764.80	764.35	0.46
May 10, 2022	PM	1,108	5,576	6,836	1,054	12,466	1,008	14,528	82,042	42,434	3,911	51,363	99,427	27.40	18.18	764.72	764.47	0.25
May 11, 2022	AM	1,166	5,063	7,122	1,009	12,341	929	14,279	82,622	42,620	3,792	51,845	99,685	27.44	18.30	764.80	764.58	0.22
May 11, 2022	PM	1,282	4,547	7,140	909	12,061	810	13,779	83,278	42,742	3,656	52,142	99,805	27.46	18.37	764.87	764.64	0.23
May 12, 2022	AM	1,347	4,966	7,049	825	12,537	694	14,056	83,682	42,771	3,502	52,156	100,415	27.55	18.37	764.94	764.68	0.26
May 12, 2022	PM	1,476	5,022	6,936	709	12,725	572	14,006	83,995	42,878	3,330	51,955	100,622	27.59	18.33	764.97	764.70	0.27
May 13, 2022	AM	1,539	4,988	6,684	628	12,583	480	13,691	84,586	42,981	3,143	51,911	100,791	27.61	18.32	765.02	764.74	0.28
May 13, 2022	PM	1,666	5,316	6,325	554	12,753	394	13,702	85,046	43,195	2,920	51,490	101,114	27.66	18.22	765.05	764.72	0.33
May 14, 2022	AM	1,721	5,897	6,164	516	13,266	339	14,121	84,665	43,156	2,677	50,689	100,947	27.64	18.03	764.99	764.67	0.32
May 14, 2022	PM	1,829	6,003	6,378	500	13,710	319	14,529	84,672	42,809	2,398	50,957	101,099	27.66	18.09	764.97	764.62	0.35
May 15, 2022	AM	1,867	6,043	7,006	496	14,419	303	15,219	84,421	42,542	2,100	51,288	101,243	27.68	18.16	764.91	764.58	0.33
May 15, 2022	PM	1,941	5,448	7,657	454	14,593	263	15,309	84,430	42,253	1,791	51,887	101,075	27.65	18.30	764.88	764.52	0.36
May 16, 2022	AM	1,957	4,568	8,173	416	14,282	228	14,925	84,429	42,013	1,483	52,299	100,421	27.54	18.40	764.85	764.47	0.38
May 16, 2022	PM	1,988	4,168	8,490	400	14,246	203	14,849	84,289	41,811	1,212	52,383	99,950	27.47	18.42	764.79	764.44	0.35
May 17, 2022	AM	1,981	3,955	8,770	396	14,309	193	14,899	84,020	41,498	972	52,457	99,495	27.40	18.43	764.70	764.39	0.31
May 17, 2022	PM	1,965	4,118	9,060	360	14,783	202	15,339	83,809	41,069	747	52,749	99,541	27.40	18.49	764.65	764.29	0.36
May 18, 2022	AM	1,935	3,706	9,307	316	14,632	231	15,179	83,929	40,693	549	53,323	99,341	27.36	18.63	764.63	764.23	0.39
May 18, 2022	PM	1,876	3,992	9,477	299	15,045	247	15,591	84,333	40,654	436	53,839	100,061	27.47	18.75	764.72	764.21	0.51
May 19, 2022	AM	1,828	4,499	9,521	365	15,481	236	16,024	83,706	40,665	432	53,230	99,855	27.44	18.61	764.61	764.21	0.41
May 19, 2022	PM	1,731	4,667	9,561	453	15,507	250	16,148	82,835	40,177	547	53,016	99,138	27.32	18.55	764.45	764.10	0.35

Column =>

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

Date		Assiniboine River							Red River									
		Shellmouth Flow Reduction (Routed to Headingley) Recorded	Portage Diversion flow (Routed to Headingley) Recorded	Actual Assiniboine R. flow at Headingley Recorded	Natural breakouts from river Computed	Natural Assiniboine River flow at Headingley =1+2+3-4	Sturgeon Cr. Flow plus other local inflows Rec. & Est.	Natural Assiniboine R. flow into Red River =5+6	Red River flow U/S of Floodway Computed	Red River Floodway flow Recorded	La Salle flow Recorded	Red River flow at James Ave. Recorded	Natural Red River flow at James Avenue =1+2-4+9+10	Natural water level on Red R. At James Ave (feet) Computed	Recorded Water level on Red R. at James Ave (feet) Recorded	Natural water level on Red R. at Floodway Inlet (feet) Computed	Recorded Water level on Red R. at Floodway Inlet (feet) Recorded	Below Natural at Floodway Inlet (feet) Computed
May 20, 2022	AM	1,670	4,802	9,661	544	15,589	315	16,372	83,225	40,182	755	53,774	99,884	27.44	18.73	764.56	764.12	0.44
May 20, 2022	PM	1,548	5,169	9,814	631	15,900	356	16,756	83,105	41,012	1,238	53,502	100,599	27.56	18.68	764.63	764.30	0.33
May 21, 2022	AM	1,479	5,366	9,900	660	16,085	383	16,961	82,132	41,084	1,770	53,102	100,370	27.53	18.58	764.57	764.27	0.30
May 21, 2022	PM	1,341	5,556	9,964	610	16,251	371	17,031	82,178	40,961	2,005	53,558	100,806	27.59	18.69	764.61	764.23	0.38
May 22, 2022	AM	1,270	5,988	10,015	624	16,649	324	17,304	81,913	40,784	2,050	53,518	100,935	27.61	18.68	764.59	764.21	0.39
May 22, 2022	PM	1,128	6,521	10,049	685	17,012	255	17,567	81,578	40,570	1,940	53,252	100,785	27.58	18.61	764.54	764.18	0.36
May 23, 2022	AM	1,058	6,771	10,058	726	17,161	207	17,667	81,312	40,253	1,714	53,039	100,394	27.52	18.55	764.48	764.11	0.37
May 23, 2022	PM	919	6,785	10,010	688	17,026	170	17,495	81,087	39,864	1,416	52,818	99,698	27.41	18.50	764.38	764.01	0.38
May 24, 2022	AM	854	7,151	9,933	737	17,201	147	17,648	80,674	39,207	1,136	52,684	99,159	27.32	18.46	764.24	763.87	0.38
May 24, 2022	PM	725	7,378	9,844	739	17,207	128	17,635	80,304	38,564	908	52,620	98,547	27.22	18.43	764.11	763.73	0.38
May 25, 2022	AM	666	8,041	9,745	855	17,598	115	18,009	79,787	37,472	725	52,900	98,225	27.16	18.49	763.99	763.48	0.51
May 25, 2022	PM	550	7,997	9,704	774	17,477	104	17,836	79,463	36,469	579	53,381	97,623	27.05	18.60	763.88	763.26	0.62
May 26, 2022	AM	499	7,670	9,686	656	17,200	94	17,510	78,645	35,907	481	52,999	96,420	26.86	18.50	763.66	763.13	0.53
May 26, 2022	PM	399	7,420	9,658	560	16,917	85	17,202	77,552	35,241	404	52,459	94,959	26.62	18.36	763.38	762.96	0.42
May 27, 2022	AM	358	7,255	9,622	510	16,724	80	17,004	76,836	34,441	343	52,439	93,983	26.45	18.35	763.20	762.75	0.45
May 27, 2022	PM	276	6,922	9,585	425	16,358	65	16,624	76,019	33,606	296	52,359	92,738	26.24	18.32	762.98	762.53	0.45
May 28, 2022	AM	245	6,888	9,588	414	16,307	73	16,580	75,082	32,428	261	52,577	91,724	26.07	18.36	762.76	762.23	0.53
May 28, 2022	PM	184	6,535	9,647	353	16,013	263	16,476	73,883	31,445	228	52,577	90,387	25.84	18.35	762.48	761.97	0.51
May 29, 2022	AM	165	6,177	9,694	301	15,735	431	16,366	72,574	30,473	197	52,424	88,938	25.59	18.30	762.14	761.67	0.47
May 29, 2022	PM	127	6,013	9,747	279	15,607	389	16,196	72,288	29,525	179	53,077	88,463	25.50	18.45	762.04	761.42	0.63
May 30, 2022	AM	120	6,135	9,752	306	15,701	240	16,152	71,588	28,732	164	53,013	87,693	25.36	18.43	761.86	761.20	0.66
May 30, 2022	PM	107	5,832	9,763	371	15,331	536	16,203	69,711	28,087	153	52,075	85,730	25.03	18.20	761.35	761.01	0.35
May 31, 2022	AM	112	5,859	9,984	505	15,449	1,000	16,901	70,089	28,220	229	53,082	86,767	25.20	18.44	761.51	761.01	0.51
May 31, 2022	PM	122	5,832	10,761	661	16,054	1,333	17,888	71,531	30,653	1,406	54,379	90,324	25.82	18.78	762.26	761.55	0.72
June 1, 2022	AM	137	5,654	11,027	678	16,140	1,478	18,118	70,885	31,716	2,445	54,118	90,948	25.93	18.72	762.37	761.85	0.52
June 1, 2022	PM	168	5,596	10,892	651	16,005	1,147	17,652	70,297	31,877	2,971	53,431	90,420	25.85	18.56	762.32	761.92	0.40
June 2, 2022	AM	190	6,282	10,734	747	16,459	912	17,867	69,650	31,385	3,248	53,158	90,269	25.82	18.49	762.26	761.82	0.44
June 2, 2022	PM	235	7,110	10,590	860	17,075	711	18,240	69,103	30,696	3,307	53,016	90,197	25.80	18.45	762.19	761.64	0.55

Column =>		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
		Assiniboine River							Red River										
Date		Shellmouth Flow Reduction (Routed to Headingley) Recorded	Portage Diversion flow (Routed to Headingley) Recorded	Actual Assiniboine R. flow at Headingley Recorded	Natural breakouts from river Computed	Natural Assiniboine River flow at Headingley =1+2+3-4	Sturgeon Cr. Flow plus other local inflows Rec. & Est.	Natural Assiniboine R. flow into Red River =5+6	Red River flow U/S of Floodway Computed	Red River Floodway flow Recorded	La Salle flow Recorded	Red River flow at James Ave. Recorded	Natural Red River flow at James Avenue =1+2-4+9+10	Natural water level on Red R. At James Ave (feet) Computed	Recorded Water level on Red R. at James Ave (feet) Recorded	Natural water level on Red R. at Floodway Inlet (feet) Computed	Recorded Water level on Red R. at Floodway Inlet (feet) Recorded	Below Natural at Floodway Inlet (feet) Computed	
June 3, 2022	AM	262	7,466	10,412	869	17,271	580	18,261	68,422	29,827	3,195	52,782	89,467	25.67	18.38	762.01	761.43	0.58	
June 3, 2022	PM	315	7,211	10,260	729	17,057	435	17,823	67,455	28,712	2,951	52,388	87,898	25.40	18.28	761.67	761.14	0.53	
June 4, 2022	AM	344	7,027	10,213	638	16,947	331	17,548	66,621	27,095	2,609	52,679	86,508	25.15	18.34	761.35	760.69	0.66	
June 4, 2022	PM	402	6,352	10,216	463	16,507	250	16,961	65,588	25,629	2,156	52,581	84,501	24.79	18.31	760.93	760.26	0.67	
June 5, 2022	AM	433	5,891	10,145	341	16,129	203	16,496	64,379	23,729	1,597	52,596	82,309	24.39	18.29	760.44	759.74	0.71	
June 5, 2022	PM	496	5,497	10,075	244	15,824	173	16,124	62,827	21,928	1,114	52,262	79,938	23.95	18.20	759.89	759.25	0.63	
June 6, 2022	AM	530	4,823	10,040	135	15,258	160	15,524	61,058	19,543	803	52,518	77,279	23.44	18.25	759.20	758.53	0.67	
June 6, 2022	PM	598	4,617	9,998	89	15,124	150	15,351	59,380	17,587	611	52,552	75,265	23.05	18.24	758.62	757.98	0.65	
June 7, 2022	AM	635	4,416	9,959	53	14,957	140	15,155	57,552	15,664	489	52,476	73,138	22.64	18.21	758.02	757.35	0.66	
June 7, 2022	PM	710	3,854	9,912	50	14,425	126	14,601	55,871	14,107	410	52,212	70,833	22.19	18.14	757.42	756.85	0.57	
June 8, 2022	AM	749	3,792	9,849	50	14,341	113	14,504	54,390	12,635	343	52,060	69,187	21.86	18.10	756.94	756.26	0.68	
June 8, 2022	PM	829	3,452	9,803	45	14,038	100	14,184	53,033	11,395	294	51,835	67,466	21.51	18.04	756.46	755.79	0.67	
June 9, 2022	AM	869	3,165	9,771	42	13,763	90	13,895	51,658	10,168	252	51,604	65,763	21.17	17.97	755.99	755.26	0.72	
June 9, 2022	PM	949	2,935	9,765	40	13,609	77	13,726	50,405	9,166	220	51,301	64,311	20.86	17.89	755.57	754.86	0.71	
June 10, 2022	AM	985	2,790	9,728	40	13,463	66	13,568	49,201	8,121	191	51,064	62,921	20.56	17.83	755.16	754.38	0.78	
June 10, 2022	PM	1,059	2,591	9,706	35	13,321	57	13,414	48,010	7,186	168	50,756	61,556	20.27	17.76	754.77	753.99	0.78	
June 11, 2022	AM	1,090	2,443	9,669	32	13,170	53	13,255	46,964	6,149	150	50,687	60,337	20.01	17.74	754.42	753.50	0.92	
June 11, 2022	PM	1,151	2,292	9,653	39	13,058	58	13,155	45,835	5,291	136	50,391	59,086	19.72	17.66	754.03	753.16	0.88	
June 12, 2022	AM	1,174	2,206	9,627	46	12,961	65	13,072	44,685	4,406	123	50,093	57,833	19.43	17.59	753.64	752.77	0.87	
June 12, 2022	PM	1,219	2,058	9,626	45	12,859	84	12,988	44,116	3,776	126	50,176	57,184	19.28	17.61	753.44	752.57	0.87	
June 13, 2022	AM	1,232	1,888	9,604	42	12,682	59	12,783	43,218	3,247	121	49,755	56,080	19.03	17.50	753.12	752.33	0.79	
June 13, 2022	PM	1,256	1,738	9,548	45	12,497	60	12,602	42,315	2,570	109	49,461	54,981	18.77	17.42	752.80	752.06	0.74	
June 14, 2022	AM	1,255	1,664	9,545	50	12,415	72	12,536	41,499	2,008	111	49,219	54,096	18.55	17.36	752.52	751.74	0.79	
June 14, 2022	PM	1,254	1,473	9,543	73	12,197	80	12,349	40,972	1,611	138	49,121	53,386	18.38	17.33	752.33	751.53	0.80	
June 15, 2022	AM	1,238	1,221	9,515	90	11,884	67	12,041	40,548	1,468	179	48,842	52,678	18.21	17.26	752.16	751.32	0.84	
June 15, 2022	PM	1,206	686	9,540	77	11,354	56	11,487	39,805	1,152	127	48,376	51,342	17.88	17.14	751.84	751.04	0.80	
June 16, 2022	AM	1,173	356	9,551	58	11,022	-1513	9,566	41,007	849	112	48,308	50,628	17.71	17.12	751.99	750.79	1.19	
June 16, 2022	PM	1,107	410	9,582	50	11,050	-2,309	8,791	41,171	560	130	48,014	50,042	17.56	17.04	751.95	750.65	1.30	

Table B-2 - Red River Floodway Inlet Natural Water Level Rating Table

		NATURAL ASSINIBOINE RIVER FLOW CONTRIBUTION (cfs)										
cfs		0	5,000	10,000	15,000	20,000	25,000	30,000	35,000	40,000	45,000	50,000
NATURAL RED RIVER AT JAMES AVENUE FLOW (cfs)	20,000	742.1	740.4	738.7	737.4							
	30,000	746.6	745.2	743.9	742.6	741.5						
	40,000	750.4	749.2	748.0	746.9	745.8	744.9					
	50,000	753.8	752.7	751.7	750.7	749.7	748.8	747.9				
	60,000	756.8	755.9	754.9	754.0	753.1	752.2	751.4				
	70,000	759.7	758.8	758.0	757.1	756.3	755.5	754.7				
	80,000	762.4	761.6	760.8	760.1	759.3	758.5	757.8				
	90,000		763.9	763.2	762.6	761.9	761.2	760.6	759.9			
	100,000		765.6	765.3	764.8	764.1	763.5	762.9	762.3			
	110,000		766.7	766.3	765.9	765.5	765.2	764.7	764.2			
	120,000		767.6	767.5	767.2	766.8	766.5	766.1	765.7	765.4		
	130,000		768.5	768.2	768.0	767.7	767.5	767.3	767.0	766.6		
	140,000			768.7	768.7	768.6	768.4	768.1	767.9	767.6	767.4	
	150,000			769.1	769.0	768.8	768.7	768.6	768.5	768.5	768.3	
	160,000			769.6	769.4	769.2	769.1	768.9	768.8	768.7	768.5	768.5
	170,000			770.1	769.9	769.8	769.6	769.5	769.3	769.2	769.0	768.8
	180,000			770.5	770.4	770.3	770.2	770.0	769.9	769.7	769.5	769.4
	190,000				770.5	770.5	770.5	770.5	770.3	770.2	770.1	769.9
	200,000				770.7	770.6	770.6	770.5	770.5	770.5	770.5	770.5
	210,000				770.9	770.8	770.7	770.7	770.6	770.6	770.5	770.5
220,000				771.1	771.0	770.9	770.8	770.7	770.7	770.6	770.5	
230,000				771.2	771.2	771.1	771.0	770.9	770.8	770.7	770.7	
240,000					771.5	771.4	771.3	771.2	771.1	771.0	770.9	
250,000					771.8	771.7	771.6	771.6	771.5	771.4	771.3	
260,000					772.1	772.0	772.0	771.9	771.8	771.7	771.6	
270,000					772.4	772.4	772.3	772.2	772.1	772.1	772.0	
280,000					772.8	772.7	772.6	772.5	772.5	772.4	772.3	
290,000					773.1	773.0	772.9	772.8	772.8	772.7	772.6	
300,000					773.3	773.3	773.2	773.1	773.1	773.0	772.9	

Note: Open water conditions under steady state (no ice)