

1 Introduction

After the 1997 flood, the Manitoba Government reconvened the Manitoba Water Commission (MWC) and tasked the Commission to review the operation of the Red River Floodway during the 1997 flood. One of the many issues for the MWC was review of the Floodway's Program of Operation and the determination of what "natural" water levels would have been for the 1997 flood as discussed in their report (Manitoba Water Commission, 1998). One of the many recommendations from the MWC was that the Floodway's Program of Operation should be reviewed by the Province in full consultation with the federal government, the City of Winnipeg (CoW) and residents in the Valley.

Subsequent to the MWC report, a Floodway Operation Review Committee was formed, with a report being issued December 1999. One of the recommendations of the Red River Floodway Operation Review Committee (1999) was that:

"the 'natural' water level relationship be recomputed. To assure that the relationships receive broad acceptance, the computation should be done under the supervision of a technical working group of representatives from the provincial and federal governments, from the City of Winnipeg, and from the valley south of the Floodway Control Structure"

In December 2002, Acres was awarded the study by Manitoba Water Branch (MWB) to carry out a study to recompute the "natural" water levels at the Floodway Inlet for a full range of Red River and Assiniboine river flows. In keeping with the recommendations of the Floodway Operation Review Committee report, the Minister set up a Steering Committee, supported by a Technical Sub-committee (TSC). All the members on the TSC were senior technical water resource engineers from either government or the University. The following individuals sat on the TSC.

- Rick Bowering Study Project Manager, MWB.
- Cass Booy retired professor, University of Manitoba.
- Maurice Sydor Environment Canada, Hull, Quebec.
- Tony Kettler PFRA, Winnipeg.
- Eugene Kozera MWB.

Acres met with the TSC on four occasions during the study to discuss study progress, results to date and to receive direction on the study.

The determination of “natural” levels at the Floodway Inlet is fundamental to the operation of the Floodway. Under the current operating rules of the Floodway (Red River Floodway Operation Review Committee, 1999), the Floodway is to operate to ensure that:

- the water surface elevation at the entrance of the Red River Floodway channel does not rise above “natural”, unless the water surface elevation at James Avenue reaches 24.5 ft or the water level along the Red River within the City of Winnipeg reaches two feet below the Flood Protection Level of 27.83 ft (Rule 1); and,
- once the river levels within the City of Winnipeg reach the limits described in Rule 1, the levels in Winnipeg would be held constant and levels upstream of the Floodway would be allowed to rise above natural. If levels are forecast to rise more than 2 ft above natural, the City of Winnipeg must proceed with emergency raising of the dykes and other temporary protection measures (e.g., further closure of their sewer systems from high river levels). The water levels within the City should be permitted to rise as construction proceeds on raising the dykes (Rule 2).

According to the Red River Floodway Operation Review Committee (1999) natural is defined as follows:

“natural does not mean levels that would have occurred with no man made effects, such as agricultural development in the valley, or urbanization in Winnipeg. Rather “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”

For the purposes of this backwater study, the absence of flood control works means without Shellmouth Reservoir, Portage Diversion, Assiniboine Dykes and Red River Floodway. It is also interpreted to mean without primary dykes that were constructed in the fall of 1950 and without temporary dykes such as the Lyndale Dyke that was successful in protecting the Norwood/St. Boniface area during the 1950 flood. The “point in time” when this condition of “natural” would apply would be just prior to the 1950 flood.

The computation of natural levels at the Floodway Inlet is a two-step process:

- first, anticipated flows are calculated for the City of Winnipeg (at Redwood Bridge) had the Shellmouth Reservoir, Portage Diversion, the Assiniboine River dykes and the Red River Floodway not been built; and,
- secondly, using the above computation of “natural” flows in Winnipeg (at Redwood Bridge), a lookup is then made of a two-dimensional rating curve to determine what the water surface elevation at the Floodway Inlet would be under “natural” conditions (Manitoba Natural Resources, 1984). The table is two-dimensional to account for the varying backwater effects of the Assiniboine River on water levels at the Floodway Inlet.

While some of the preliminary backwater analysis had been carried out by the Red River Basin Investigation (RRBI) in the 1951 to 1953 timeframe (cf Appendix B, Section B2.1), the majority of the detailed hydraulic calculations were made by the Province following the release of the 1958 Royal Commission on Flood Cost-Benefit which recommended construction of a 60,000 cfs capacity floodway around the City of Winnipeg. In the spring of 1959, field investigations were carried out to relocate the Floodway Inlet from a point near the South Perimeter Highway (a recommendation of the Royal Commission) to a point upstream of the Town of St. Norbert, a distance of about 8 kilometres. The final location of the inlet was approved in 1960. Subsequent to this, detailed hydraulic investigations were carried out to determine “natural” conditions at the Floodway Inlet for a range of Red and Assiniboine river flows (Weber, 1973).

In 1965, the Floodway Inlet Rating Curve was finalized and documented in a 1970 report (Water Resources Branch, 1970). The 1965 rating curve required classifying the Assiniboine River contribution as minimum, average or maximum and then referring to the rating curve to determine what the natural level at the Floodway should be. Based on recommendations of the Manitoba Water Commission (1980), the above-described 1965 multiple-plot rating curve was converted into a numerical formula and documented in a 1984 report (Manitoba Natural Resources, 1984). The 1984 report also codified shifts in the Redwood Bridge rating curve after the 1950 flood that were being applied manually, see Appendix E.

Some of the differences between the Province’s early 60’s analysis and the current Acres analysis are as follows:

- back in the early 1960's the backwater calculation would have been done by hand using lookup tables and slide rules. At that time the number of scenarios tested would have been limited. Now, backwater analysis is done by sophisticated computer backwater models that allow a multitude of scenarios to be tested;
- in the early 1960's, model calibration was solely based on data collected from the 1950 flood. For the current re-computation, data from both the 1950 and 1966 flood was used. Prior to using the 1950 and 1966 data, Acres performed a quality control (QC) review of the data. As outlined in Section 2.0 there are QC problems with the 1950 data that were not known at the time of the earlier study;
- the modelling done in the early 1960's was based on the available topographical information of the time to define overbank elevation. In the Acres study, detailed topographical information has been generated from a variety of sources to better define the area (Appendix B3.1);
- in this study topographical and backwater modelling was linked to a GIS system to allow the graphical visualization of model construction and results; this type of technology was not available when the original study was done.

This report begins with a quality control review of the historical flood data been considered for use in this study (Section 2). Parallel to that review, physical cross-sections for the backwater study were developed from a 3-dimensional model of the floodplain. Development of the model is defined briefly in Section 3.2 and more fully in Appendix B. Following development of the physical cross-section base of the backwater model, methodology was developed for calibrating the model to in-channel and out-of-channel floods and the model calibrated to historical flood data. Once the model was calibrated the model was extrapolated to higher flows to compute an overall "natural" rating curve for the Floodway Inlet. The results of the study are discussed in Section 4.