Red River Watershed Management Board

STAR
VALUE
METHOD

(Adopted July 1991)
(Revised March 2000)

The STar Value method is intended to provide a quick and easy method for the Red River Watershed Management Board to estimate the value of a project in achieving the goal of reducing peak mainstem flows. It is a tool to be updated by the technical advisory committee annually. It is based on parameters that can be determined during early stages of a project development and which can be kept up-to-date as the project moves through various funding steps. The method strongly favors projects which are designed and operated to achieve long detention times. The STar value equation, as it presently stands is:
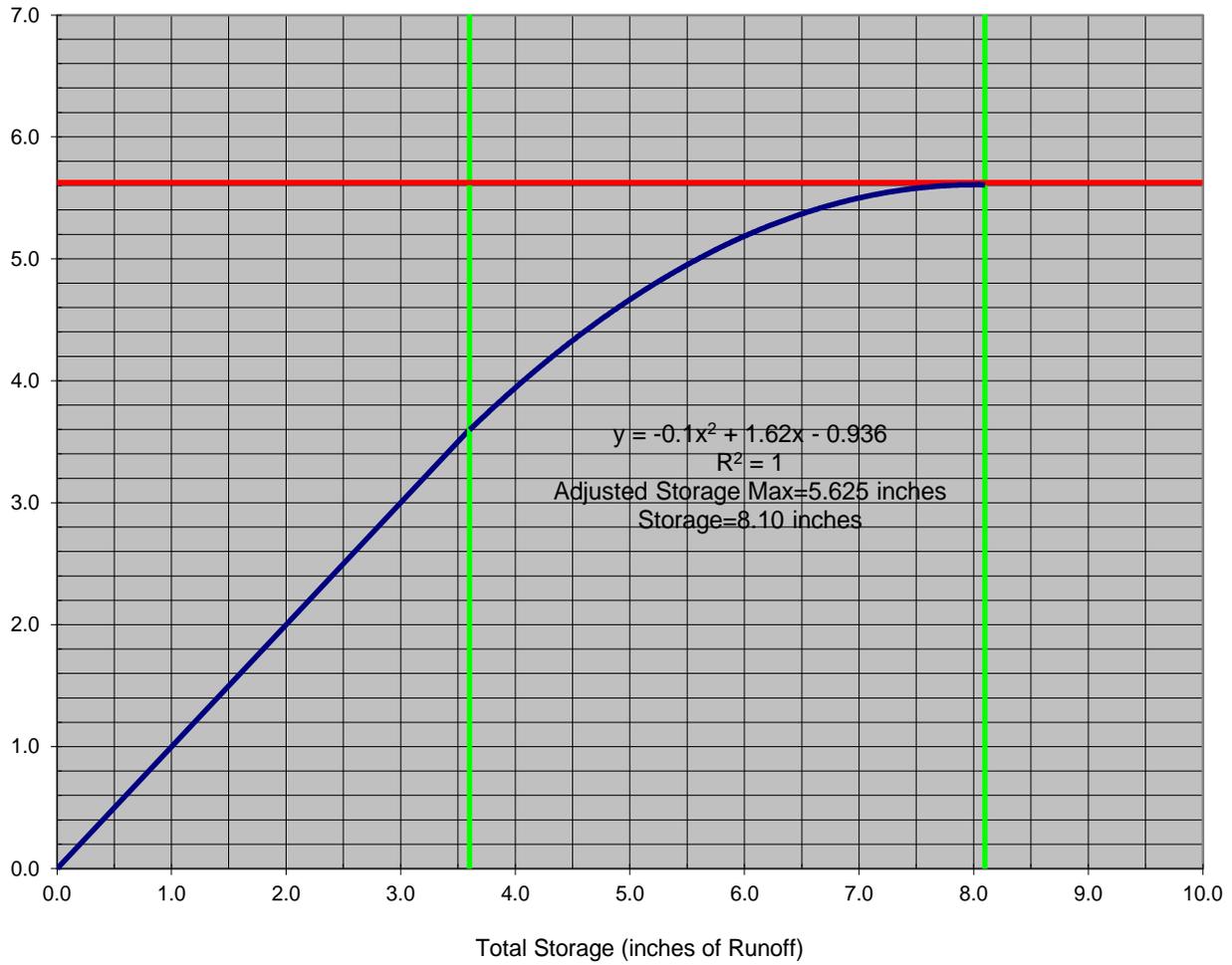
STar Value = S*T
>> Where:
>>> S = adjusted storage volume in acre-feet. The adjustment from figure 1 is applied to the storage provided first to the ungated storage, second to the gated storage and third to the drawdown storage.
>>> T = relative value of the detention time in days (Figure 3). The relative value is applied to the storage provided to the ungated storage, the gated storage and to the drawdown storage.

The Storage Adjustment Curve (Figure 1) is to be utilized and applied to the total volume of storage below the emergency spillway. This curve reduces the value of storage when the storage exceeds 3.6 inches (average 10-year runoff). The curve should not be applied to volumes greater than 8.2 inches.

Figure 1
Storage Adjustment Curve

$y = -0.1x^2 + 1.62x - 0.936$
$R^2 = 1$
Adjusted Storage Max=5.625 inches
Storage=8.10 inches

Total Storage (inches of Runoff)

The flood storage volume a project will provide is measured from the spring drawdown pool elevation to the emergency spillway elevation. This volume is divided into three categories based on potential detention time: ungated volume, gated volume, and drawdown volume. (For a two-stage outlet structure, the ungated volume will be pro-rated between the primary and secondary spillways).

Detention time is defined as the average holding time of the stored volume. This should be based on the 100-year spring runoff event. It is graphically depicted below (Figure 2) for an ungated impoundment.

Figure 2
Detention Time
Ungated Storage

~ Inflow
~ Outflow
• Center of Mass
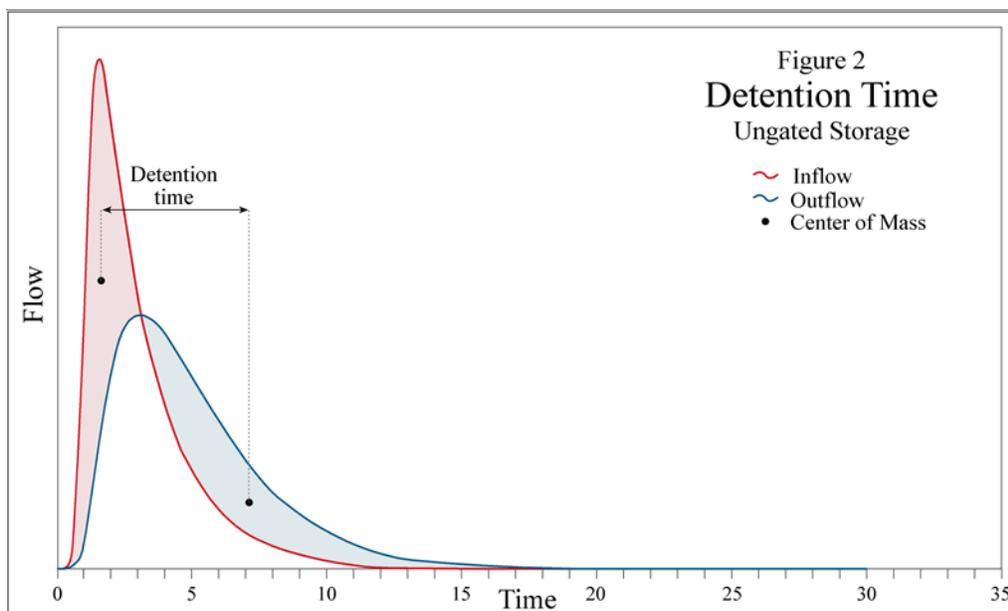
For convenience, the detention time of the <u>ungated</u> storage volume may be calculated by estimating the discharge time for 90% of the ungated storage volume and dividing this time by 2. The detention time for the <u>gated</u> storage volume is calculated using the maximum time of gate closure (based on operation plan) plus one half of the discharge time for 90% of this volume. The detention time for the <u>drawdown</u> storage volume is assumed to equal 23 days for purposes of determining the STar value. Drawdown storage volume is defined as that part of the total storage volume that will be available in the spring but not in the summer based on the operating plan.

A computational sheet is provided for use in calculating the STar value for any given project.

Figure 3
Relative Value of Detention Time

4
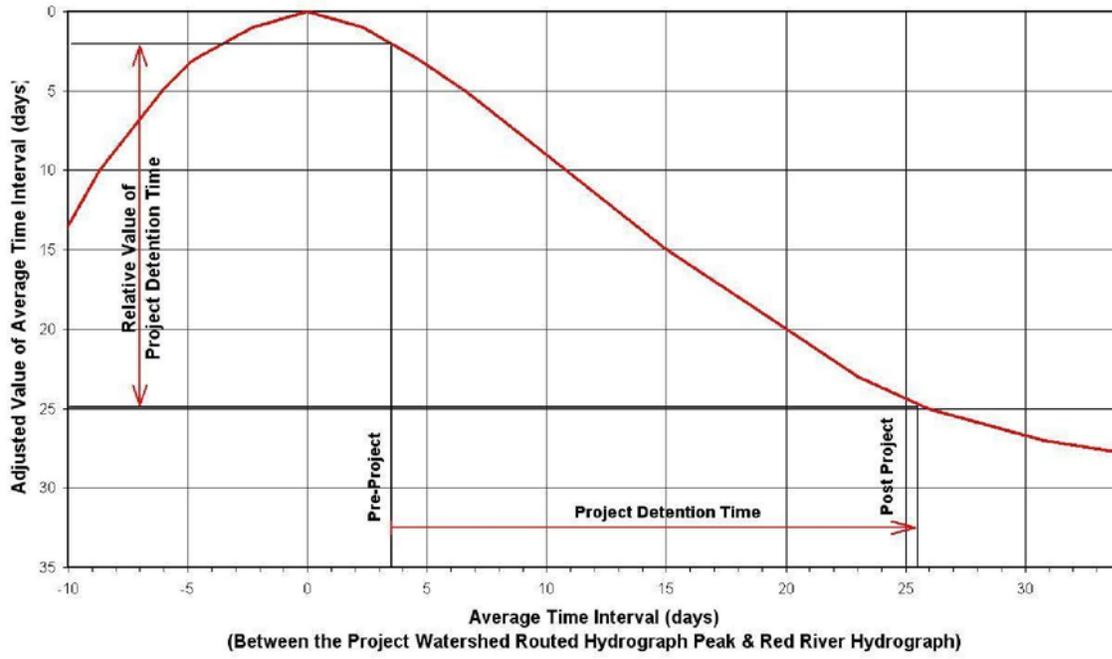
RRWMB "STar VALUE" CALCULATION WORKSHEET

PROJECT NAME: _____   DRAINAGE AREA: _____

STORAGE VOLUMES: *Adjusted   Adjusted

	Acre-feet	Inches	Adjusted Inches		Acre-feet S)
Ungated (E Spillway)	_____	_____	_____	=>	_____
Gated	_____	_____	_____	=>	_____
Drawdown	_____	_____	_____	=>	_____
TOTALS	_____	_____	_____		_____

                                                            ^
            x Adjustment factor (Fig. 1)   _____   ^
              = Adjusted Total   _____   -------   ^

DETENTION TIME:

UNGATED detention time   = $\underline{90\% \text{ Ungated volume (AF)}}$ / 2 =   _____ Days
                               Average discharge (AF/Day)

GATED detention time   =
(detention time in   + $\underline{90\% \text{ Gated volume (AF)}}$ / 2 =   _____ Days
operation plan)   Average discharge (AF/Day)

DRAWDOWN detention time   =   __23__ Days

TOTAL RELATIVE VALUE OF THE DETENTION TIME (T):

Average time interval between project location and Red River peak   =   _____ Days
                                                                          (From Table 1)

        Total relative value of the detention time, T: (From Figure 2)
                T (Ungated Storage)   = _____ Days
                T (Gated Storage)   = _____ Days
                T (Drawdown Storage)   = _____ Days

"STar VALUE" COMPUTATION: (S x T)
Where S = Adjusted Storage (acre-feet) and T = Relative value of the detention time (days)

	S	x	T	=	Star Value
Ungated	_____		_____		_____
Gated	_____		_____		_____
Drawdown	_____		_____		_____
		Total Star Value		=	_____

  *The adjustment to storage should first be applied to the ungated storage.

Table 1

Average Time Interval between the Routed USGS Gaged
Watershed Hydrograph and the Red River Hydrograph Peak

Description	Days before (-) Days after (+) Peak
Bois de Sioux nr White Rock	15
South Branch Buffalo River @ Sabin	-3
Buffalo River nr Hawley	-3
Buffalo River nr Dilworth	-3
Wild Rice @ Twin Valley	0
Wild Rice River @ Hendrum	0
Marsh River nr Shelly	-1
Sand Hill River @ Climax	0
Red Lake River @ Highlanding	5
Thief River @ TRF	5
Clearwater @ Plummer	6
Lost River @ Oklee	3
Clear Water @ Red Lake Falls	2
Red Lake River @ Crookston	0
Middle River @ Argyle	-6
Two Rivers @ Lake Bronson	-6