TRANSIENT CONTROL IN LOWER SACRAMENTO RIVER[a]

Discussion by Danny L. Fread,[2] M. ASCE

The author is to be commended for presenting a practical application of Wylie's (8) proposed method for transient flow control using the method of characteristics. The writer wishes to present the following comments, corrections, and points that need additional clarification by the author.

Although it is not specifically stated by the author, it appears that Eqs. 3 and 5 must be solved simultaneously since they constitute a system of nonlinear equations with two unknowns, y_p and V_p. The nonlinearity results from using the trapezoidal rule for integrating along the characteristics lines. Eqs. 3 and 5 would be linear with respect to the unknowns if a first-order or Euler-type integration were used. Due to the nonlinear features of the equations, the Newton iteration method should be used to obtain efficient solutions.

What was the magnitude of Δt used by the author?

The negative sign associated with the term, $1/C_p$, in Eq. 11 should be a positive sign, since Eq. 11 follows directly from Eq. 5. Also, the first term in Eq. 18 should be preceded by a negative sign.

It is not apparent how the term, V_T, is to be evaluated in Eq. 20. Eqs. 17-20 constitute a system of four equations with four unknowns V_G, y_G, V_F, y_F, which implies that V_T must be specified. The author states that Q_T, the tributary discharge, is specified as a known function of time; however, it seems that additional information is required for V_T to be specified. Also, since the author assumes that Q_T can be specified as a known function of time, he implies that Q_T is not a function of the stage at the confluence of the tributary and the principal river. This basic assumption is not true, particularly when the bottom slope of the tributary is mild, in which case the tributary is subject to significant backwater effects from the principal river. How does the author consider this in the application of Eqs. 17-20 for tributary inflow?

How far upstream of the Sacramento weir is the upstream boundary located? The author states that the upstream boundary condition is a forecast discharge hydrograph. However, if the upstream boundary is near the weir, the operation of the weir may affect the upstream discharge such that the specified boundary condition is erroneous.

Eq. 12 should be expressed in terms of the absolute velocity so that the computed energy slope will have the correct algebraic sign for flow directed either downstream or upstream. Thus

$$S_p = \left[\frac{n}{(1.486)\,R_p^{0.667}}\right]^2 |V_p|\,V_p \qquad (29)$$

[a]March, 1974, by Fred J. Gientke (Proc. Paper 10418).

[2]Research Hydro., Hydrologic Research Lab., National Weather Service, National Oceanic and Atmospheric Administration, Silver Spring, Md.

As the author suggests, the stage-discharge loop effect should be included in the downstream boundary condition, particularly if the adjusted invert slope, S_o, is very mild. The writer (9) has found that the loop effect may be significant if $S_o < 0.0001$ when the rate of change in stage is greater than approx 0.1 ft/hr. The loop effect, which is a manifestation of the variable energy slope due to changing discharge, can be considered in the computations at the downstream boundary as follows:

$$V_p - V_R + \left(\frac{1}{2}\sqrt{\frac{gT_R}{A_R}} + \frac{1}{2}\sqrt{\frac{gT_p}{A_p}}\right)(y_p - y_R)$$

$$+ \frac{gn^2}{2(2.208)}(t_p - t_R)\frac{|V_p|\,V_p}{R_p^{4/3}} + \frac{g}{2}(S_R - 2S_o)(t_p - t_R) = 0 \quad \ldots\ldots\ldots (30)$$

$$V_p - \frac{1.486}{n}R_p^{2/3}\left[S_o - \left(\frac{y_p - y_{A'}}{\Delta x}\right) - \frac{1}{g}\left(\frac{V_p - V_c}{\Delta t}\right)\right.$$

$$\left. - \frac{1}{2g}\left(\frac{V_p^2 - V_{A'}^2}{\Delta x}\right)\right]^{1/2} = 0 \quad \ldots\ldots\ldots (31)$$

in which $y_{A'}$ and $V_{A'}$ = the depth and velocity at time $(t + \Delta t)$ of the station immediately upstream of the downstream boundary. Eqs. 30 and 31 constitute a system of two nonlinear equations with two unknowns, y_p and V_p. Eq. 30 results from the application of the C^+ in Eq. 3 at the downstream boundary, and Eq. 31 is the Manning equation in which the energy slope, S_f, is approximated by a finite difference expression of Eq. 1. Eqs. 30 and 31 can be solved by the Newton method for a system of nonlinear polynomials.

Appendix.—References

9. Fread, D. L., "A Dynamic Model of Stage-Discharge Relations Affected by Changing Discharge," *NOAA Technical Memorandum NWS Hydro-16,* U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, Silver Spring, Md., Nov., 1973.

WINTER-REGIME THERMAL RESPONSE OF HEATED STREAMS[a]

Discussion by Edward Silberman,[4] F. ASCE

The authors have presented a one-dimensional calculation method for predicting the occurrence of open water produced by a warm water discharge to a river

[a]April, 1974, by Poothrikka P. Paily, Enzo O. Macagno, and John F. Kennedy (Proc. Paper 10479).

[4]Prof., St. Anthony Falls Hydraulic Lab., Univ. of Minnesota, Minneapolis, Minn.