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Letters to the Editor

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FLOOD ROUTING FOR THE DHALEGAON-BABLI REACH OF RIVER *GODAVARI*

1. Flood routing is the process of determining progressively the timing and shape of a flood wave at successive points along a river stream and is basic for flood forecasting. The present communication presents some results of the flood routing studies of the Dhalegaon-Babli reach of river *Godavari*, which may be useful to the engineers involved in various projects of the river basin and also to the hydrologic modellers.

The biggest lift irrigation scheme in Maharashtra called the Vishnupuri project is under construction on river *Godavari* at 8 km upstream of Narded town contemplating an annual utilization of 11.4 T.M.C. of water to irrigate 28,340 hectares of land annually. This project was approved in 1979 by the Government of Maharashtra and the main work commenced in November 1982 which is expected to cost abcut 650 million ruppees as per the revised estimates.

In the calibration of medium and major river basins using digital hydrologic models, one has to divide them into several sub-basins depending upon the areal extent, stream pattern and other morphological characteristics. For instance, Ramanamurthy *et al.* (1984) have divided the Narmada basin into twenty sub-basins for applying OPSET model for estimating probable maximum flood (PMF) at Navagam dam site. A majority of digital models including OPSET do not have the capability to route the flows of the main river and tributary flows in proper time phase. In this way the streamflow routing plays an important role in digital modelling besides its conventional application.

2. *Data used*—Daily stage and discharge and hourly stage data measured at three sites, namely, Dhalegaon, Purna and Babli (60 km downstream of Nanded) for the period 1971-75 have been utilized in this study (Fig. 1). For obtaining hourly discharge values corresponding to the observed stages, rating/calibration curves (Carter & Davidian 1965) for all the years of study for the above three sites have been prepared utilizing observed daily stage and discharge data. These rating curves have been extended/extrapolated using the method given by Linsley *et al.* (1982). From these curves hourly discharge values corresponding to the observed stage during the selected major flood events have been obtained and utilized for the study.

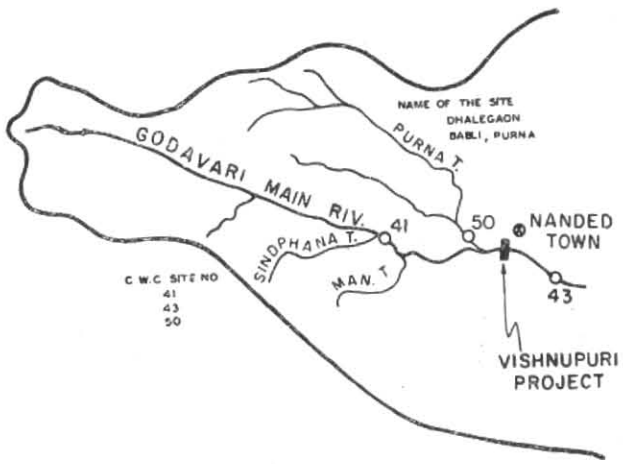

Fig. 1. Location of stations along *Godavari*

3. *Method*—As a flood wave passes along a natural channel some of the water is stored temporarily with the amount depending upon the dimension and variability of the channel and flood plain. Storage in the channel increases as long as inflow exceeds outflow. All methods of flood routing are based on the law of continuity, *viz.*, the volume of water discharged from a reach during an interval must equal the inflow *minus* the change in storage.

The Muskingum method of streamflow routing (McCarthy 1938) is the most commonly used and sufficiently accurate for all practical purposes.

The Muskingum storage equation is :

$$S = K[X.I + (I - X)\,O]$$

where,

S = Storage within the routing reach at a given time in m^3.

K = Slope of storage-weighted discharge relation, dimension of time.

X = Dimensionless constant which weights the inflow and outflow.

I = Rate of inflow at the upstream end in m^3 sec^{-1}.

Q = Rate of outflow from the downstream end in m^3 sec^{-1}.

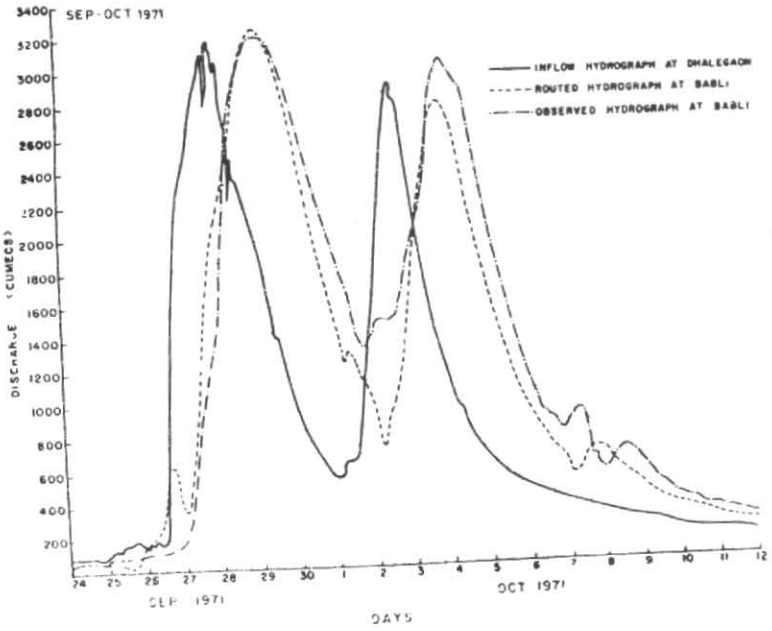

Fig. 2. Inflow, routed & observed hydrographs, Sep-Oct 1971

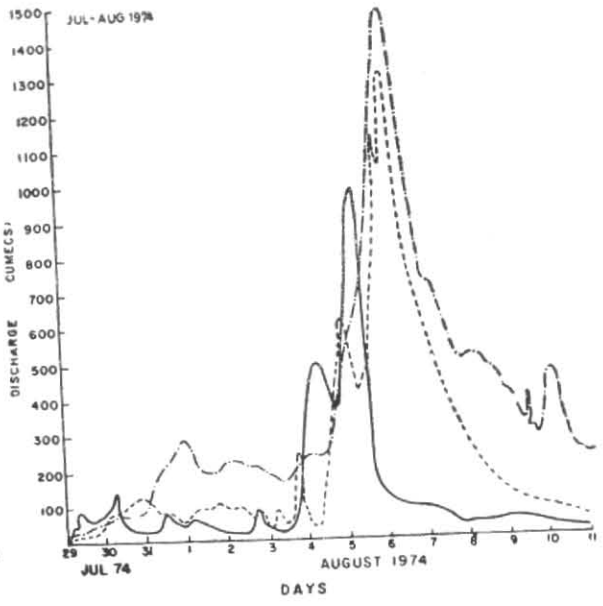

Fig. 3. Inflow, routed & observed hydrographs, Jul-Aug '74

Solution procedure for determining the Muskingum constants K and X with examples are given in many of the recent hydrology text books (Varshney 1979, Viessmann *et al.* 1977).

4. In order to derive the values of K and X for the *Godavari* river reach Dhalegaon-Babli, several flood hydrographs during 1971-75 were plotted and examined. Then twelve flood event periods were selected for further analyses. Based on the nature of the twelve selected hydrographs (observed) at the upstream and downstream points plotted together; a tentative set of constants are taken and two events are routed. Then the synthesized hydrograph derived by routing at the downstream end Babli was compared with the observed one. The constants are then altered on the basis of a critical examination of the differences between the observed and routed flows. The process is continued for four to five times until a best match between observed and routed is obtained.

These constants finally obtained are taken as the approximate Muskingum constants and two such cases are shown in Figs. 2 & 3. In a similar way routing for the other events were performed and the average constants were obtained. There are widely varying situations in the twelve selected events for the purpose. For instance, in case of Sep-Oct 1971 (Fig. 2), the runoff contribution from the region between Dhalegaon to Babli is considerably less while an opposite situation existed in the case of Jul-Aug 1974 event (Fig. 3).

In doing the above, the observed flows at Dhalegaon are first routed up to the confluence of Purna site(147 km). The observed flows at Purna site are added to them in proper time phase and then the combined flows are obtained. In the second step, the combined flows are routed from Purna confluence to Babli (90 km).

5. *Result*—Average constants for the first portion of the reach Dhalegaon to Purna confluence are found to be $K=23$ hr and $X=0.4$ and for the second portion, *i.e.*, between Purna and Babli, they are obtained as $K=14$ hr and $X=0.4$.

Hence, for the entire reach Dhalegaon-Babli, the Muskingum constants would be $K=37$ hours and $X=0.4$.

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