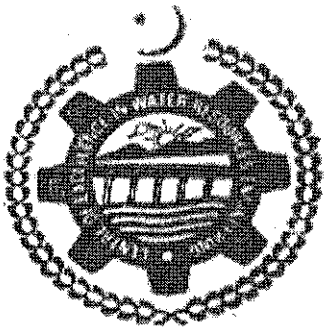
THESIS

MODELING OF GROUNDWATER DRAINAGE FOR STREAM-AQUIFER INTERACTIONS



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ABSTRACT

Groundwater interacts with the surface water in nearly all landscapes, ranging from small streams, lakes and wetlands in the headwater areas to major river valleys and seacoasts. The amount of available surface water along a river for irrigation, drinking or any other use is governed by the flows in the river and depends on water transfer with subsurface aquifers. Quantification of the base flow through understanding of stream-aquifer interactions is important for successful management of downstream located irrigation schemes and municipal water uses. Quantification of stream flow during base flow conditions i.e. when the flow in the stream is almost wholly governed by groundwater changes can provide information about the availability of water for irrigation and municipal use during the dry periods.

Stream-aquifer interaction studies are usually complex due to the involvement of numerous dynamic parameters. In this study a simple approach embedded multi reservoir technique is utilized for the modeling of aquifer drainage to the stream. The approach involves groundwater drainage equation explicit in time. It is assumed that the drainage from the aquifer behaves exactly like the discharge from the linear reservoir.

The study was conducted on a gaining stream Nullah Baan located in southern part of AJK region. Stage data and rainfall data was collected in the field for a period of 120 days on daily basis. Elevation survey was conducted at the research site to measure the elevations of the selected points for the installation of the staff gauge and for the measurement of cross sectional area of the stream at different stations. Staff gauge was installed at the site in order to record the stage.

To evaluate and quantify the stream-aquifer flow exchange, a variety of data were needed. River stage reading was taken on daily basis to monitor the river stage variations while rainfall data was recorded on hourly basis in the catchment. To measure the discharge

in field cross sectional data was collected and velocity measurements were made with the help of digital meter FLOW MATE 2000. Et data was assumed.

Occasionally discharge measurements were made in the field. Entering geometric data for the stream in HEC RAS 3.1.3 and calibrating it against known discharges, water surface profiles and rating curves at the site was obtained. With the help of rating curve corresponding discharges were found. The base flow was separated representing the aquifer contribution to the stream .There was no evidence of snowfall in the catchment of target stream.

Stream aquifer flow exchange was calculated using groundwater flow equation explicit in time by developing excel model. Assuming initial storage value, drainage coefficient and delay factor adjusting parameters and comparing both synthesized and estimated hydrographs. Using hit and trial method it was attempted to minimize the error in fitting. Fitting was evaluated using statistical methods.

During the study period the catchment received 411 mm of rainfall. The Nullah Baan flow was measured as 103.45 MCM (65.39 mm), direct run off 29.45 MCM and base flow as 73.99 MCM. The base flow was 71.52 % of total flow. Simulated base flow was found as 75.64 MCM and showed a difference of 0.041 % from measured results. Drainage coefficient was found 0.002, average rainfall recharge as 0.005 mm/hr and initial basin storage of 8.17 Mm^3 for the catchment of Nullah Baan. It was found that the approach is simple and quite accurate for determination of drainage from the aquifer.

It is recommended that the embedded multi reservoir technique should be utilized in simulating surface water body-aquifer interaction within conjunctive management models because of efficiency, accuracy and minimum computational cost. Moreover, it is recommended that results from the approach should be compared with other models like river package in MODFLOW.