Experiment No. 1

“To Understand Storm Hydrograph”

Apparatus Name: Advanced Hydrological Apparatus

HYDROGEOLOGY LAB

CENTRE OF EXCELLENCE IN WATER RESOURCES ENGINEERING

UET, LAHORE

Procedure

1) Stream Flow from a Single Storm:

Before this experiment is carried out, the sand tank should be set to a slope of about 1 %. Smooth the sand in the tank: to give a smooth surface parallel to the top edge of the tank:, then use the sand scoop to create a channel of rectangular cross section centrally down the length of the tank: between the river inlet and the deep outlet at the foot. The channel should be approximately 4 cm wide by 2 cm deep.

Connect the flexible piping from the overhead spray nozzles to the quick release connector on the 3 l/min flow meter.

a) Stream Flow for a Long Duration Storm (See Figure 1):

Turn on the spray nozzles to simulate rainfall and select a rainfall flow rate of between 1 and 3 l/min. Allow rain to fall long enough to give a steady run-off value. Turn off the flow and record the recession limb of the hydrograph. Use a stopwatch started (zero time) at commencement of rainfall and read weir discharge as frequently as necessary to show the hydro graph form.

The experiment may be repeated for different rainfall flow rates, smaller catchment areas (by closing some of the valves to the rainfall nozzles) and for small differences in slope.

b) Stream Flow from a Short Duration Storm (See Figure 1):

(Less (60% - 80%) than time of concentration)

Proceed as in a) but cut off rain while hydro graph is still rising Figure 1 will result.

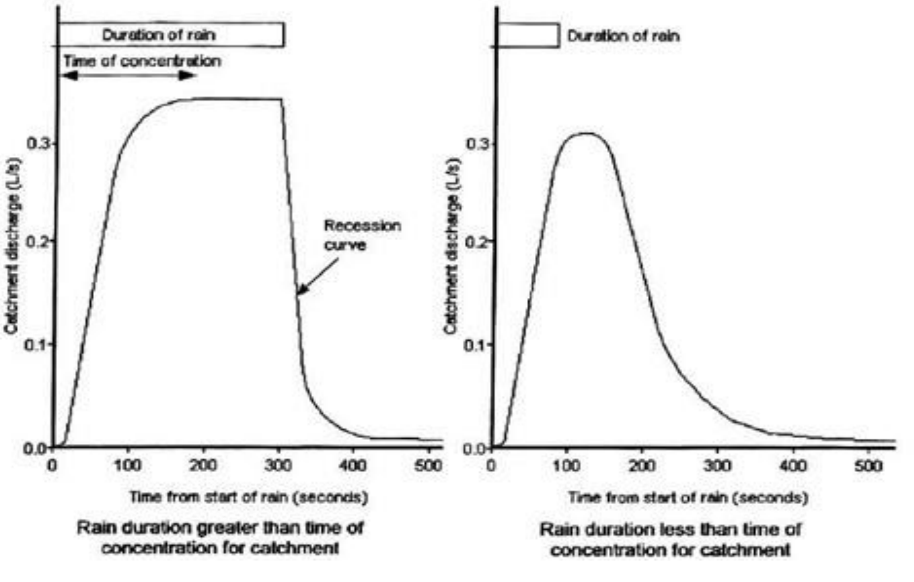

Figure 1

c) Histogram:

The hydro graph should properly be shown as in Figure 1 by plotting the results directly.

It may be found that the best-shaped storm hydro graphs are obtained when the "rain" is stopped just before the maximum run-off is obtained. That is to say, the duration of the storm is slightly less than the time of concentration for the catchment. If the rain persists after the water table reaches the surface, then direct run-off over the surface occurs. When the rain stops before this occurs, the run-off is only in the form of ground water flow. It is recommended that different slopes and surface profiles be tried until the most suitable hydro graph is obtained.

2) Stream Flow from Multiple Storms:

Connect the flexible piping from the river inlet tank to the quick release connector on the 5 l/min flow meter. Connect the flexible piping from the overhead spray nozzles to the quick release connector on the 3 l/min flow meter. The sand bed should be allowed to drain following any previous use of the apparatus. This experiment can be carried out by arranging a first storm of duration rather less (say 50%) than the time of concentration, tc (as obtained in the previous experiment).

Follow it by a second storm of the same duration while the recession limb of the first one is still quite high. The discharge values must be recorded continuously from the start of the first storm, and the resulting double hydro graph when plotted will show the much larger run-off values obtained for the second storm which falls on a previously saturated catchment. The method for drawing the hydro graph, outlined in "Stream Flow for a Single Storm", may be used.

3) Stream Flow from an Impermeable Catchment (urbanization):

After investigating the rainfall run-off relationships for a permeable catchment, it is of interest to reduce the permeability of the catchment surface by covering part or all of it with the impermeable Polythene sheet provided with the accessory items. If only the upper part of the catchment (away from the discharge end) is sealed in this way, then the run-off from the plastic sheet is lost in the sand in the lower part. If, however, the lower part of the catchment only is covered, the run-off is more immediate and the effect on the hydro graph more marked. The plastic sheet provided should be trimmed with a knife or scissors to fit the required catchment area.

4) Stream Flow from a Highly Vegetated Catchment

The effect of a highly vegetated catchment may be simulated by covering part or all the catchment surface with the absorbent material provided.

5) Stream Flow with Reservoir Storage

The effect of a flood detention reservoir on the run-off from a standard storm can be demonstrated by using the accessories provided. The circular ended ring can be used when partly buried in the sand to form a circular reservoir, and the closed ring can, similarly, be used to retain the rain that falls on it and to release the water slowly through the center aperture. It may prove necessary to use all available vessels to simulate detention reservoirs and it will be found that inverted dustbin lids serve well so long as they have a small drainage hole made in their center.

6) Effect of Land Drainage on run-off Hydrograph:

One of the commonly employed methods of improving land drainage is the construction or renewal of ditch systems. Different model ditch systems can be constructed on the sand surface in the catchment tank and their effects on the run-offs hydro graph of a standard storm compared.

Observation and Calculations:

Time Since Start of Run (sec)	Rainfall Flow Rate (l/min)	River Inlet Flow Rate (l/min)	Flow Rate Over Weir (l/min)

Assignment:

a) Describe the catchment area and initial channel planform.

b) Draw Diagram of catchment area.

c) Discuss the results obtained in the experiments performed.

d) Plot graphs (run-off hydrographs) of run-off flow rate against time since start of rainfall for each set of data.

e) Describe the shape of each hydro graph, and comment on the effects of each parameter on the run-off experienced.

f) Suggest reasons for any deviation from the expected results.