THESIS

EFFECT OF COLLECTOR PERFORATIONS ON DRAINAGE DESIGN AND PERFORMANCE OF SUB-SURFACE DRAINAGE SYSTEM

By

SYED ZIA HUSSAIN SHAH
(98-PG-WRM-13)

For the Degree of

MASTER OF SCIENCE

IN

WATER RESOURCES MANAGEMENT

CENTRE OF EXCELLENCE IN WATER RESOURCES ENGINEERING

UNIVERSITY OF ENGINEERING AND TECHNOLOGY,

LAHORE, PAKISTAN

2000

ABSTRACT

EFFECT OF COLLECTOR PERFORATIONS ON DRAINAGE DESIGN AND PEROMANCE OF SUB-SURFACE DRAINAGE SYSTEM

Sub-surface pipe drainage system is one of remedial measures adopted to combat the problems of waterlogging and salinity in Pakistan. Sub-surface pipe drainage system consists of plastic pipes laid below ground level at certain depth. In conventional approach of drainage design, laterals are considered to receive water from the soil profile and discharge it into collector. Collectors are considered to transport water and ultimately dispose it out of the area. The collectors are considered blind and therefore are considered to receive water from the soil profile. But due to the use of plastic perforated pipes for collector, it can extract water from soil profile of surrounding areas. The direct extraction of drainage water by perforated collector is usually ignored in drainage design showing a gap in theory and practice of drainage design. The present study was conducted to quantify the extent of drainage water extraction by perforated collectors and evaluate how benefit of direct pickup of drainage water by perforated collectors can be incorporated in subsurface drainage design.

This study is a combination of field experiments and desk study. Data was collected for trial site 1in FESS project area where sub-surface drainage was provided by pipe drains. Data was taken for watertable depth and cropping pattern. Discharges from laterals and collectors were measured at manholes and sump unit respectively. Hydrogeological properties of soil profile were also measured through field experiments. The groundwater flow model MODFLOW was then used to determine the conductance of drains and to evaluate the effect of collector perforations in extracting drainage water from adjacent area

of collector under existing recharge and boundary conditions. MODFLOW was further used with earlier determined drain conductance to evaluate effect of collector perforations in reducing drainage water for typical drainage system layout. MODFLOW was also used to evaluate three alternates to incorporate effect of perforated collectors in drainage design. The alternates are 1) the laterals' length be increased by half lateral spacing. 2) the laterals be kept non-perforated near the discharging end for the length equal to half of spacing. 3) the calculated drain spacing be increased by 50 %.

The effect of perforated collector is quite significant in receiving drainage water from surrounding areas and lowering of average watertable level. In case of perforated collector water flows partially into collector and partially into laterals. But for non-perforated collector all drainage water flows into the laterals. Perforated collector results in lowering watertable level varying from 0.15 to 0.72 m as compared to non-perforated collector at various recharges. It is concluded that from results that perforated collector collects a significant quantity of water. The influence of perforated collector varies from 100 to 300 m.

The benefit of perforated collector in terms of extracting significant quantities increasing lateral spacing by as much as 50% and this result in 30% reduction in pipe length required per unit area. This results in short length of pipes as compared to other options.