

## Effect of environmental flow management on river water quality: a case study at Yeongsan River, Korea

Sung Min Cha, Seo Jin Ki, Kyung Hwa Cho, Heechul Choi and Joon Ha Kim

### ABSTRACT

This paper describes a management scheme to control river water quality using additional water discharges from upstream dams, which results in an increase environmental flow (EF) followed by an enhancement of water quality in a target river. To suggest a creditable management plan among a suite of ideal scenarios, the monthly averaged water quality monitoring data from 2001 to 2006 at the Yeongsan (YS) River, Korea were investigated with respect to seasonal variation and spatial distribution. From the analysis, it was found that while biochemical oxygen demand (BOD<sub>5</sub>) level in the YS River was extremely high during the dry/drought season (April, May, and June; AMJ), the level was subsequently decreased during the monsoon season (July, August, and September; JAS) due mainly to the dilution effect of rainfall. To improve the water quality in AMJ, we here suggested a scenario of increasing EF using surplus water discharges from upstream dams, which was examined by one dimensional riverine water quality model, QUAL2E model. Simulation result showed that additional discharge from the upstream dams could lead, on average, to a 36% of water quality improvement in mainstream with respect to BOD<sub>5</sub>. Model coefficients were validated by comparing the six year monitoring data to minimize a sum of squares error, and showed a good agreement with the observed data. Overall, the methodology developed in this paper appears to be quite clear and straightforward, and thus, can be applied to a wide range of the flow managements or water quality controls in a stream with artificial structures.

**Key words** | dams, dyke, environmental flow, management scenario, QUAL2E model, river water quality

Sung Min Cha  
Seo Jin Ki  
Kyung Hwa Cho  
Heechul Choi  
Department of Environmental Science and Engineering,  
Gwangju Institute of Science and Technology (GIST),  
261 Cheomdan-gwagiro, Buk-gu,  
Gwangju 500-712,  
South Korea

Joon Ha Kim (corresponding author)  
Sustainable Water Resource Technology Center,  
Gwangju Institute of Science and Technology (GIST),  
261 Cheomdan-gwagiro, Buk-gu,  
Gwangju 500-712,  
South Korea  
E-mail: Joonkim@gist.ac.kr

### INTRODUCTION

The water quality of the Yeongsan (YS) River was found to chronically deteriorate during the dry/drought season (i.e., during April, May, and June; AMJ) because of the significantly reduced river flow rate (Ki *et al.* 2007). In fact, the YS River typically shows the worst annual water quality condition (exceeding an average of 8 mg/L of BOD<sub>5</sub>) especially for these three months, a period prior to the onset of the monsoon season. In terms of water quality management, the YS River has been the subject of a number of river managers and researchers due to its unique structure being enclosed by dams at upstream and a dike at downstream of the river (see Figure 1). The structure was known to provide

conditions that chronically caused severe deterioration of the water quality by blocking a natural circulation of a stream. To this point, a number of studies and plans including the Act on Watershed Management and Community Support (AWMCS) (<http://eng.me.go.kr/docs/>, 2006) have been suggested and implemented to improve the YS River water quality. Out of these efforts, the Ministry of Environment (ME) has so far invested about 1.6 trillion Korean Won (1.5 billion US dollars) from 2003 to 2006, (YRBEO 2007) with additional funds of about 6.1 trillion Korean Won (5.6 billion US dollars) being allocated until 2015.