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Groundwater Investigation of the Cheonggyecheon Watershed Area

Doo-Hyung Choi, Jea-Ha Yang, Sung-Chun Jun, Kang-Keun Lee,
Yoon-Young Kim *

Graduate School of Earth and Environmental Sciences Seoul National University
**Graduate School of Industrial Management Choong-Ang University*
(e-mail : giaboss@hanmail.net)

<Abstract>

The groundwater system of the Cheonggyecheon watershed is very complicated because it is influenced by many factors such as pumping out, groundwater leakages into subway stations, civil use of groundwater, and leaking water from water supply and sewage lines. So the characterization and evaluation of the groundwater flow and contaminant transport in the Cheonggyecheon water system is quite a difficult task. The purpose of this study is to analyze of the influence to the 'groundwater' below the Cheonggyecheon watershed by the 'surface water' on the Cheonggyecheon stream after the restoration. We have so far collected groundwater quality data, hydrogeologic aquifer parameters, and the amount of leakages into subway stations and its influence on the groundwater system of the Cheonggyecheon. Results show that groundwater level was influenced by the direction and depth of a subway station. This study will continue to monitor groundwater quality, a water level fluctuation relation between rainfall and groundwater recharge for further investigation of the groundwater flow system in Cheonggyecheon.

key word : Cheonggyecheon watershed, groundwater, restoration construction

1. Introduction

The total area of the Cheonggyecheon is 50.96㎢ It extends over 5 wards, Jongno-Gu, Jung-Gu, Dongdaemun-Gu, Seongbook-Gu, and Seongdong-Gu. It originated in Mt. Inwangsan, Mt. Bugaksan, and Mt. Namsan, and its total length is 10.92km. It is an urban stream that flow from west to east in the center of the Seoul. Because of fundamental solution of the deterioration on covering structure and expressway, the Seoul Metropolis decided 'Cheonggyecheon restoration' and began on July 1, 2003. The total length of restoration section is 5.5km, and is divided into 3 parts that Daelim, LG, and Hyundai construction companies are taking on.

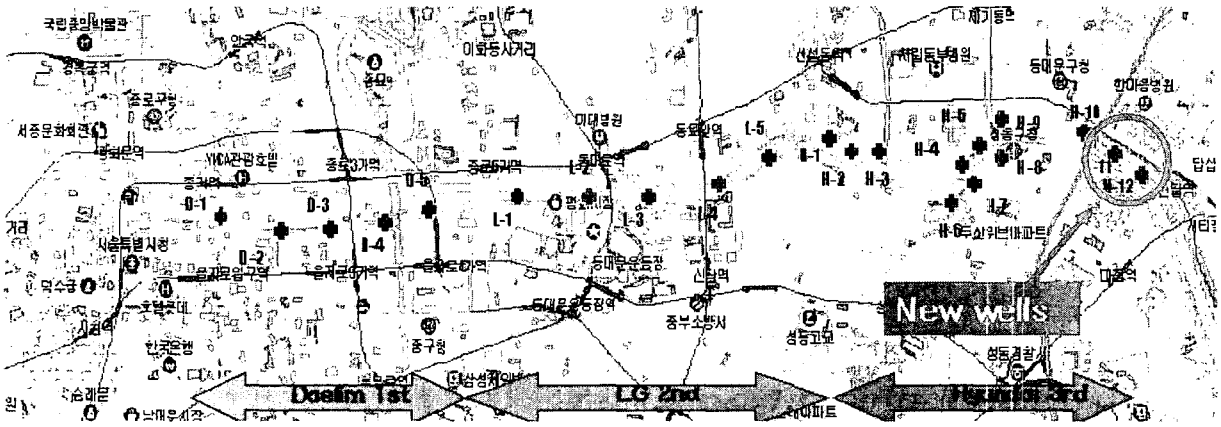

Figure 1. The description of the observation wells in the study site

2. Site description

In the study site, there are three construction stages, and total 21 wells had been installed in 2003. Some wells are in the stream bed, another wells are on the stream bank(Fig.1). The first stage is undertaken by the Daelim construction company between Cheonggye 1st street and Cheonggye 4th street. There are 5 observation wells in the bottom of Cheonggyecheon stream.

The second stage is taken charge of the LG construction company, and it is between Cheonggye 4th street and Cheonggye 8th street. There are also 5 observation wells. Nowadays, however, first and second stage has no observation well because of destruction during inside construction processes.

Last stage, Hyundai stage, is between Cheonggye 8th street and the point of joining with Jungrang-cheon, where observation wells are not in the stream bed, but on the stream bank. So, unlike Daelim and LG stages we can access to the wells to investigate the fluctuation water level and water sampling. This stage has 11 observation wells which are in left and right side on the bank of the Cheonggyecheon.

3. Monitoring of the water level fluctuation

Upper stream of the Cheonggyecheon is dry stream. So only after raining, it serves as a stream within 24 hours(Fig. 2, 3). But down stream has some affluent streams that inflow continuously. The result of investigation shows that, the fluctuation of water level is influenced by the Jeongreungcheon

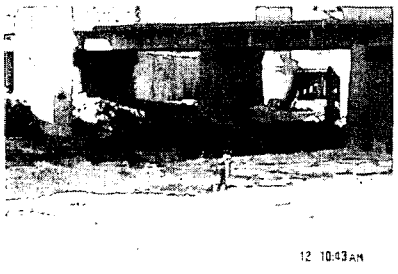

Figure 2. normal time in study site

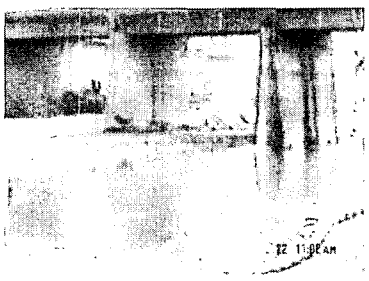

Figure 3. raining event

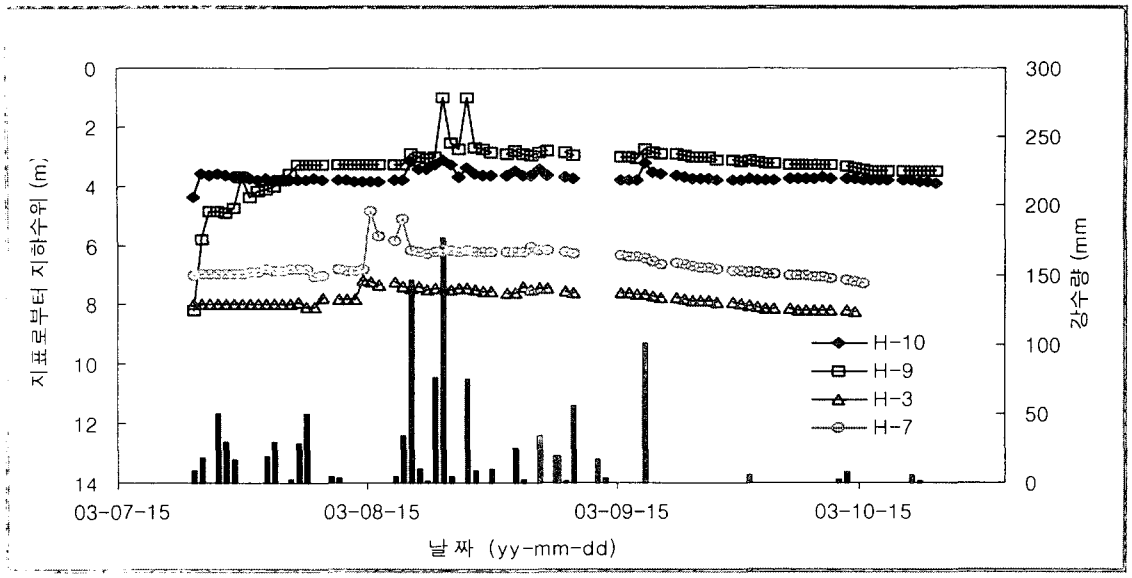

Figure 4. The water level fluctuation with the precipitation of the Hyundai 3rd stage

stream, one of an affluent stream of the Cheonggyecheon during the precipitation (Fig. 4).

4. Monitoring the leaking water from the subway stations

The prime factor that will be influenced the groundwater of Cheonggyecheon watershed is the groundwater recharged from the subway stations. There are 6 subway lines and 35 stations around a Cheonggyecheon. Especially, the Cheonggyecheon stream is located between 1st subway line and 2nd subway line like a boundary. So it is very important to estimate thing which the quantity of leaking water from subway lines. Result of the subway leaking water shows the change of quantity for time (Fig.5, 6, 7). The quantity of leaking water from the subway lines has high volume in the 3, 4, 5, 6 subway lines, because these lines were constructed under the 1, 2 subway lines. Total volume of the leaking water is 27029m^3/day in 2003, it is short of quantity to provide 60,000-100,000 ton of water for the new Cheonggyecheon steam.

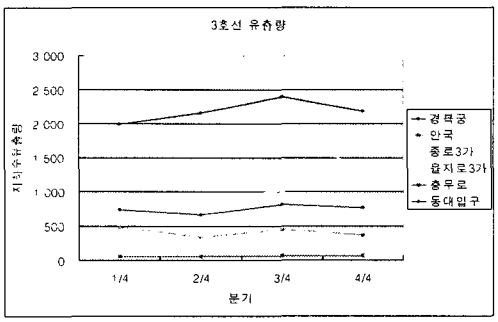

Figure 5. leaking water quantity from 3rd line (2003)

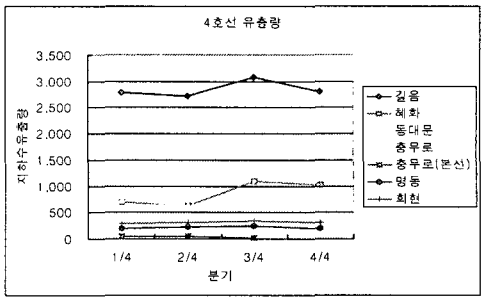

Figure 6. leaking water quantity from 4th line(2003)

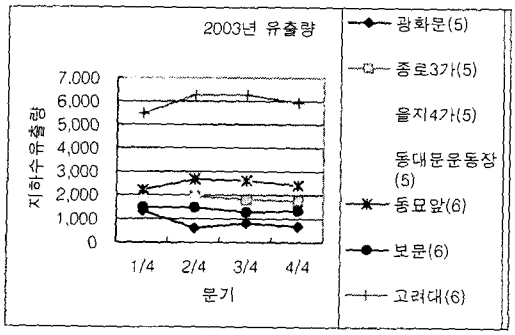

Figure 7. leaking water quantity from 5,6th line(2003)

Figure 8. performed the slug test

5. Slug test

Slug test has been conducted by causing sudden change in the water level in a well or peizometer. The purpose of slug test is to measure the horizontal hydraulic conductivity and storage coefficients of aquifers under field conditions. Hyundai stage has 8 observation wells in the stream bank. A slug test was performed in this area (Fig.8). This third construction area has no observation well in the stream. New wells are in the middle of a Cheonggyecheon nearby Shindap Bridge and Majang2 Bridge. Results of the slug test are given in Table 1 and Fig. 9. The geometric mean of conductiviting values is 5.84×10^{-6}m/s, and the conductivity of the new wells is 7.60×10^{-6}m/s.

well	K (m/sec)
H-1	2.88×10^{-5}
H-2	3.40×10^{-5}
H-3	1.46×10^{-5}
H-4	1.44×10^{-7}
H-6	8.13×10^{-7}
H-10	2.38×10^{-5}
H-11	1.16×10^{-5}
H-12	4.98×10^{-6}

Table 1. Results of the slugtest

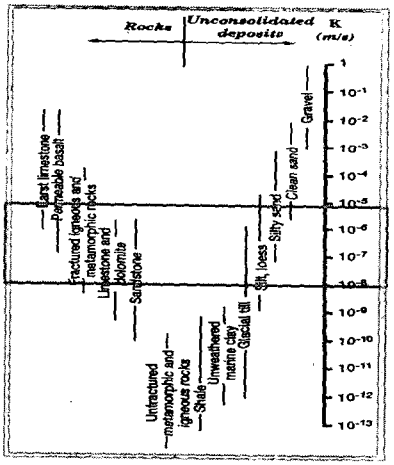

Figure 9. Batu, Aquifer Hydraulics, 1998

Acknowledgement

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Reference

Bedat Batu, Aquifer Hydraulics:a comprehensive guide to hydrogeologic data analysis, pp. 627-667, John Wiley & Sons, Inc, New York, 1998

Brent E. Clother, Infiltration, Soil and Environmental Analysis, edited by Keith A. Smith, Chris E. Mullins, pp. 239-280, Marcel Dekker, Inc., New York, Basel, 2001

Kim, Y. Y., 2000, Analysis of hydraulic properties of an urban groundwater system: groundwater system in Seoul area, Korea, Seoul National University, Seoul

Kim, Y. Y., Lee, K. K., and Sung, I. H., 1998, Groundwater Systems in Seoul Area: Analysis of Hydraulic Properties, The Journal of Engineering Geology, Vol 8, pp. 51-73

Steven A. Thomas, H. Maurice Valett, Jackson R. Weber, Patrick J. Mulholland, A regression approach to estimating reactive solute uptake in advective and transient storage zones of stream ecosystems, *Advanced in Water Resources*, 26, 965-976, 2003