An attempt to estimate the water level change of undamaged groundwater by earth resistance (II) - Preliminary observations at the PTU borehole in Musashino Upland -

*Kunihiro Ryoki[1]

1. Polytechnic University

1.Introduction

Under the Musashino plateau, which is covered by the highly permeable Kanto loam, there is a Musashino gravel layer several meters thick. The level of non-confined groundwater, staying here, has large seasonal fluctuations, and often rises to the upper loam (Kokubun,2005). Sumida(2017) pointed out that there is perchied water on the loam layer, where clay-like impermeable layers are scattered. When this water level rises, flooding may occur on the surface (Tokyo Geotechnical Consultants Association,2000).
Formerly, the author pointed out the need to prepare for floods by observing groundwater level fluctuations at many points. And as an observation method, it was investigated that a method of estimating the groundwater level based on the change in grounding resistance (Ryoki,2019a). In this study, it is reported that the results of preliminary observations on the verification of this estimation method.

2.Measurement

It was pointed out that the ground resistance changed with the groundwater level , based on the relationship between the layer thickness of the first layer and the equivalent ground resistance in a horizontal two-layer structure, as Fig.1 (Ryoki,2019b). And it was thought that the groundwater level fluctuation could be known by monitoring the fluctuation of the grounding resistance. To verify this phenomenon, an observation well was installed in the Musashino Plateau, and the fluctuation of the groundwater level was measured at 10-minute intervals. Near the observation well, It was started that the grounding resistance was measured at a safety ground electrode of the electrical equipment repeatedly. At the observation well, the temperature and electrical conductivity of groundwater were measured at 10-minute intervals. Table.1 shows the specifications of observation wells and measuring equipment.

3.Result

Fig.2 shows the groundwater level from April 2, 2019 to February 1, 2020. Observations of groundwater temperature and electrical conductivity were very stable, and only fluctuations of the resolution of the measuring instrument were recorded. According to Fig.2, there is no significant change from the start of observation to the rainy season. The groundwater level started to rise from early June. At the end of the rainy season, the water level stabilized around -12m. After that, the groundwater level rised some time due to intensive precipitation caused by the typhoon. In the season with relatively little precipitation since late autumn, the groundwater level had decreased almost linearly.
Fig.3 shows the grounding resistance in Class A grounding, which is attached a 4-story reinforced concrete building, measured during this period. The measured value on May 13, 2019 is very different from the others, but the other ones fluctuate slowly.
To compare Fig.2 and Fig.3, it is shown that the grounding resistance tended to increase when the groundwater level was low. The relationships each other were harmonious.

4. Future plans

It is being advanced that preparation for acquiring the ground resistance and the apparent resistivity of the earth at one-hour intervals.

References

Kokubun, K.(2005): A Hydrological Study of Ground-water and Springs on Musashino-upland by the Heavy Rainfall, *Annu. Re., I.C.E. of TMG 2005*, 201-208.
Ryoki,K.(2019a): An Attempt to Estimate the Level of Non-confind Groundwater by Earthing Resistance (I) -Outline of Theory-, *Proc. Jap. Geosci. U. 2019*, HTT22-03.
Ryoki,K.(2019b): A Theory of Water Level Estimation to Focus on the Change of Earthing Resistance for the Prediction of Flood Occurrence, *Jour. of Polytech. Sci.*, 35, 30-35.
Sumida, K.(2017): Landform and Unconfined Grandwater in the Center of Musashino Upland, Tokyo, *Komazawa Jour. Geog.*, 53, 35-53.
Tokyo Geotechnical Consultants Association (2000): Uplift of Shin-Kodaira Station on the JR Musashino Line, Underground structures and groundwater levels, *Tech. Re.*, 30, 21.

Keywords: electrical equipment, Musashino district, loam layers, perchied water, flood damage, equivalent earthing resistance

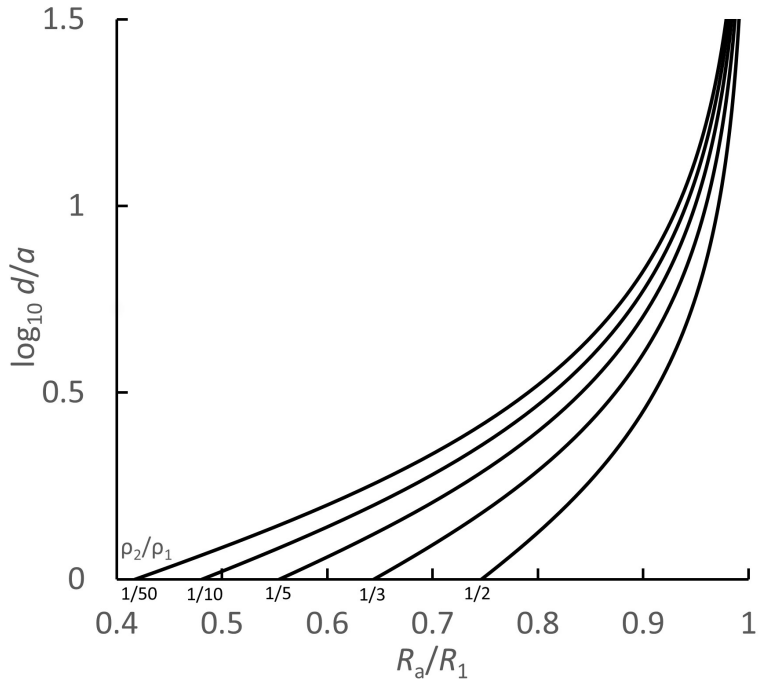

図 1 水平二層構造での第一層の層厚と等価接地抵抗の関係(領木(2019b)に加筆)

Fig.1 Relationship between the layer thickness of the first layer and the equivalent ground resistance in a horizontal two-layer structure (after Ryoki, 2019b)

表 1 観測井および測定機器の諸元

Table 1 shows the specifications of observation wells and measuring equipment

観測井	位置	35° 44' 19.2" N 139° 29' 41" E
	孔口標高	81.92m
	孔長	30.17m
	内径	50.0mm
水位計	応用地質社製	S&DL miniEC 10m計
接地抵抗計	横河製作所製	3235型

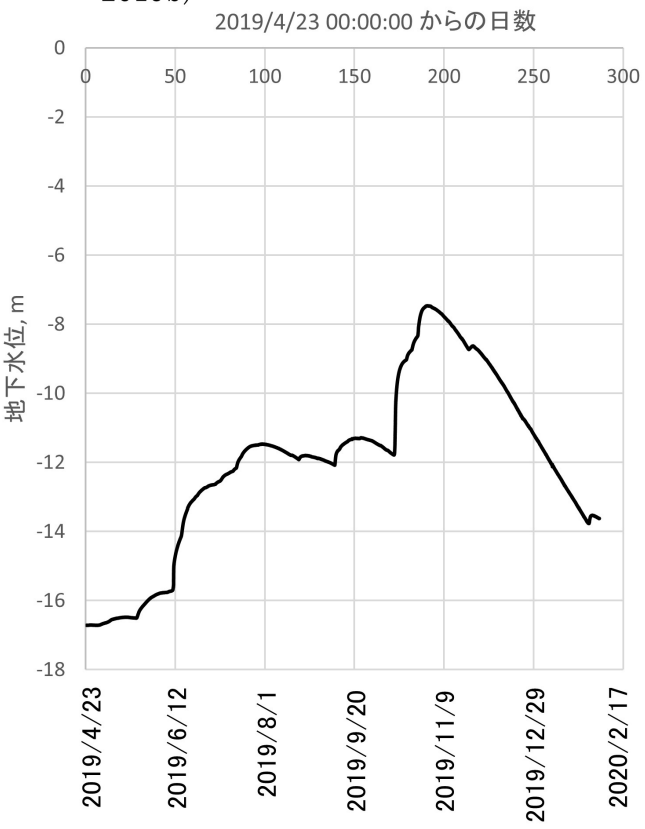

図 2 観測井PTUでの地下水位の変化

Fig. 2 Variation in groundwater level at the observation well PTU

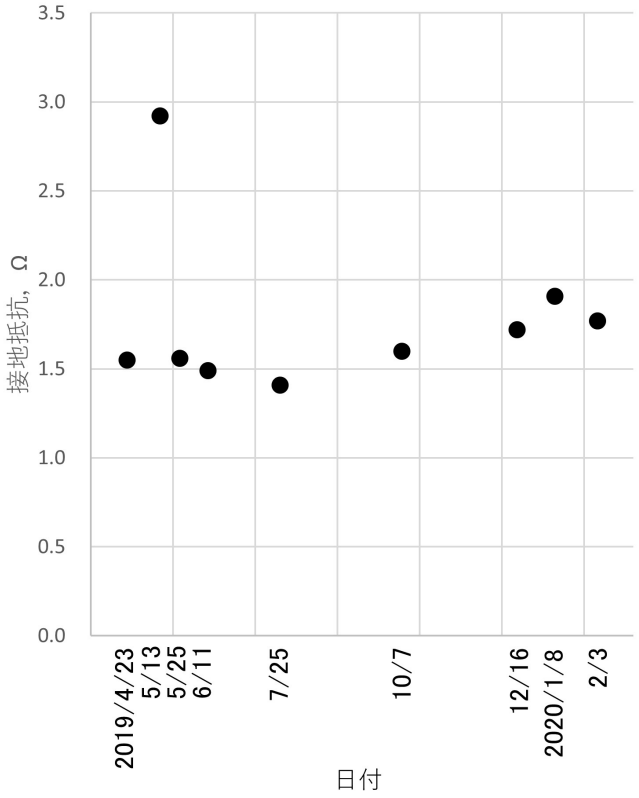

図 3 観測井PTU近傍における接地抵抗の変化

Fig. 3 Transition of grounding resistance near the observation well PTU