Management of groundwater in the Nobi Plain that modeled groundwater use for earthquake disasters and environmental preservation

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Introduction

Daito(2020) in the paper of TISOLS2020, the well is set up in the place of refuge specified in each municipality in the Nobi Plain, and the groundwater drawn up usually assumed use as the water of environmental preservation, and assumed use as the drinking water and daily life water at the disaster. The state of groundwater and the ground change were forecast by using the three-dimensional groundwater flow analysis and the perpendicular one-dimension consolidation subsidence analysis, and what should be of the large area groundwater management was examined.

As a result, it was thought that an important subsidence was not generated if it was a pump discharge of 100L or less a person/the day in each place of refuge. However, it has been understood that the decrease in the groundwater level is large in the vicinity of Nagoya City on which the place of refuge and the population have concentrated compared with other regions.

In this report, it proposed to decrease some pump discharges in the vicinity of Nagoya City. Moreover, it proposed to increase the pump discharge in the vicinity of Ogaki City with little decrease in the groundwater level even if groundwater was pumped. And, the decrease in the groundwater level was suppressed by transporting the shortfall of water to the vicinity of Nagoya City at the disaster, and the possibility of the subsidence became lower. This is a better management of the large area groundwater.

Moreover, it proposes how to use the groundwater drawn up effectively actually. Even when the disaster occurs, the groundwater of about 100L/day a person which corresponds to the volume of water of washing and cooking and washing can be pumped in each place of refuge. This groundwater becomes the source of the river of environmental prevention water to aim to attempt the improvement of the metropolitan environment in each municipality because it is possible to use it for the environmental sustainability in the water park etc. and the water quality purification by discharge to the river, etc.

Methods and results

The result of the groundwater level in the vicinity of Ogaki City has been extracted from the result of the three-dimensional groundwater flow analysis of Daito(2020). There is little decrease in the groundwater level even if a lot of groundwater is pumped from each aquifer as shown in Figure 1-3. Moreover, it is thought that it is common to all aquifers and the groundwater level is not steady

from the 1965's to the 1975's because the change in the pump discharge of each year appears in the change in the groundwater level.

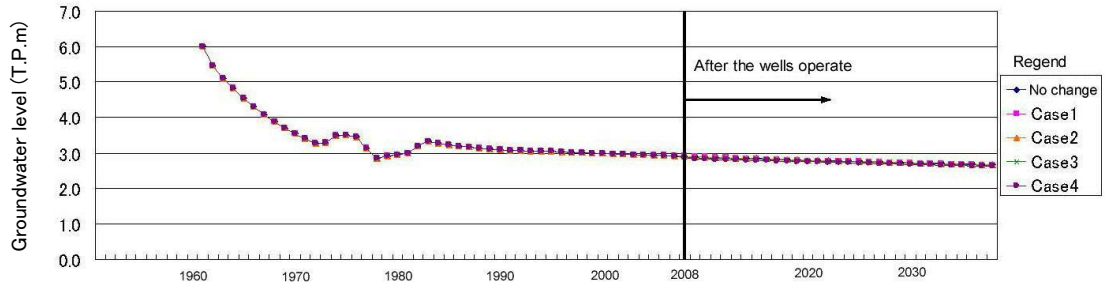

Figure 1 Annual change of groundwater in the vicinity of Ogaki observation well (G1 aquifer)

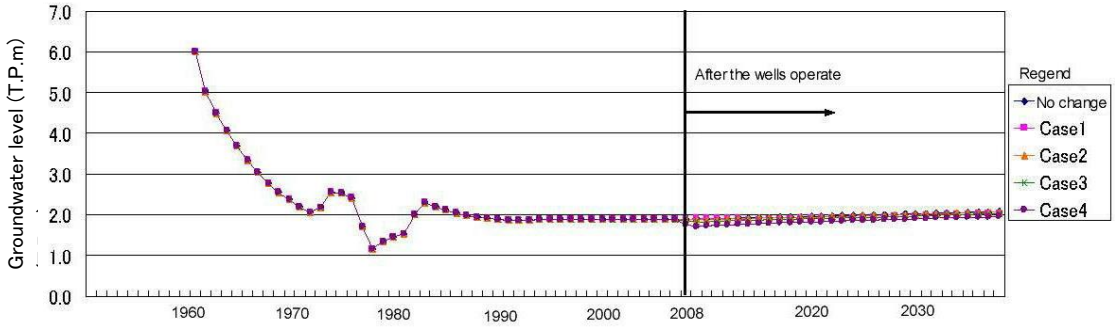

Figure 2 Annual change of groundwater in the vicinity of Ogaki observation well (G2 aquifer)

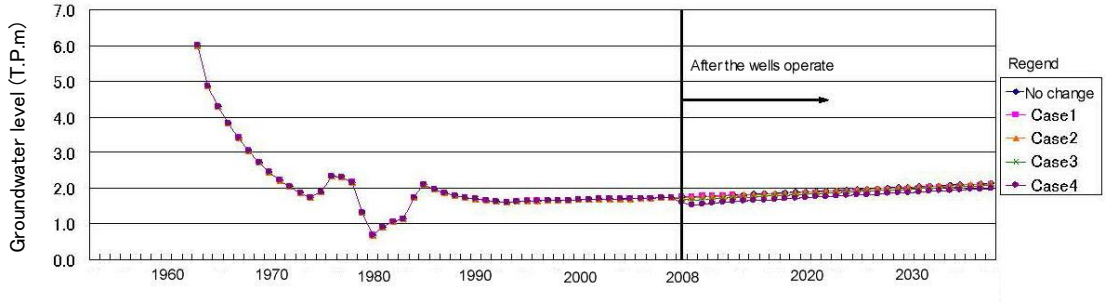

Figure 3 Annual change of groundwater in the vicinity of Ogaki observation well (G3 aquifer)

The groundwater drawn up in each place of refuge is usually used as environmental preservation water. Here, it proposes how to use it actually based on the case with the groundwater exploitation in Ichinomiya City and the Kita-ku of Nagoya City.

First of all, to secure water quality purification of the pond and an excellent landscapes, the groundwater of 350m3/day (amount of the permission pumping) is drawn up in the Aasaiyama Park in Ichinomiya City. The groundwater of about 2,419m3/year is pumped in the case of Case1, the groundwater of about 16,124m3/year is pumped in the case of Case2, the groundwater of about 80,622m3/year is pumped in the case of Case3, and the groundwater of about 201,555m3/year is pumped in the case of Case4 in the place of refuge in Ichinomiya City as shown in Table 2 of Daito(2020).

About eight places of refuse are necessary in Case2, and about two places of refuse are necessary in Case3 to cover the groundwater of 350m3/day. There are the six places of refuge from the Asaiyama Park within 1km in the radius as showing in Figure 4. A necessary amount of groundwater cannot be covered with Case2 though a necessary amount of groundwater can be covered in Case3. However, it is thought that it is possible to make up a shortfall by increasing some pump discharges a place in the place of refuge because pumping to 100L/day a person is possible.

Moreover, there are 173 places of refuges in Ichinomiya City. Therefore, it is thought that it leads to the town improvement by effectively using groundwater for a new water park etc.

Figure 4 Distribution of the places of refuge in the vicinity of Aasaiyama Park

Next, the underground water that sprang up by the Kamiiida tie line construction work in the Kita-ku of Nagoya City would be discharged 18.6 millionm3 (6.2 millionm3/year) to Horikawa River in three years of 1998 - 2001, and be useful for the water quality purification. However, discharge was discontinued with the end of construction. However, there is time when the raw water transmission cannot be done for the environmental sustainability of the Shonai River at fish's egg laying time etc. In the places of refuge in Kita-ku of Nagoya City, the groundwater of about 3,640m3/year is pumped in Case1, the groundwater of about 24,266m3/year is pumped in Case2, the groundwater of about 121,330m3/year is pumped in Case3, and the groundwater of about 303,326m3/year will be pumped in Case4 when assuming that the groundwater drawn up is used as alternative water at this time as shown in Table 2 of Daito(2020) .

There are 31 places of refuge in Kita-ku of Nagoya City, and 11 places of refuge are from Horikawa River within 1km in both shores as showing in Figure 5. Everything cannot be covered by the groundwater drawn up, because there are a lot of volume of water from the Shonai River .

However, it is thought it is useful for Horikawa's water quality purification and environmental sustainability, etc. by throwing groundwater from these 11 places of refuge to Horikawa River though the volume of water is few.

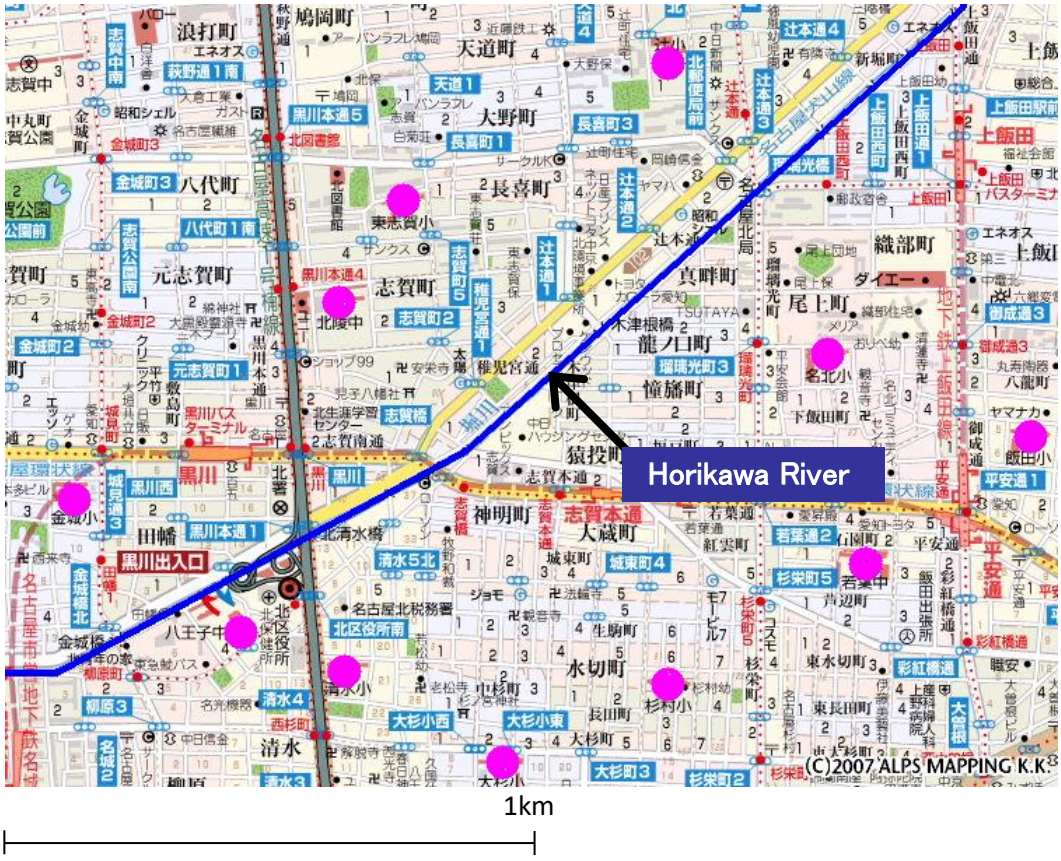

Figure 5 Distribution of the places of refuge in the vicinity of Horikawa River

Conclusion

In this report, it proposed the method of managing the large area groundwater at the disaster. It is to increase the pump discharge in the vicinity of Ogaki City with little decrease in the groundwater level even if underground water is pumped, and to decrease some pump discharges in the vicinity of Nagoya City. And, the decrease in the groundwater level in the vicinity of Nagoya City is suppressed by transporting underground water to the vicinity of Nagoya City as a shortfall of daily life water, and the possibility of the subsidence becomes lower.

Moreover, it proposes how to use the groundwater drawn up effectively actually. Even when the disaster occurs, the groundwater of about 100L/day a person which corresponds to the volume of water of washing and cooking and washing can be pumped in each place of refuge. This groundwater becomes the source of the river of environmental prevention water to aim to attempt the improvement of the metropolitan environment in each municipality because it is possible to use it for the environmental sustainability in the water park etc. and the water quality purification by discharge to the river, etc.

References

Daito, K. (2020). Management of groundwater in the Nobi Plain that modeled groundwater use for earthquake disasters and environmental preservation. Proc. *Tenth International Symposium on Land Subsidence*(TISOLS),727-731.