

A Disaster-Resistant Comprehensive Water Management System Capable of Avoiding or Reducing Large-Scale Suspensions of Service and Quick Recovery



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Introduction

At the Sendai City Waterworks Bureau, we have taken various steps to create a disaster-resistant water supply based on our experiences in the Miyagi earthquake (1978) and the lessons from the Kobe earthquake (1995). By implementing these measures, our water management system has steadily developed, so that all water facilities can be used flexibly and efficiently on a day-to-day basis as well as in times of disaster in order to provide customers with a stable water supply.

Three pillars establish the stable water supply, namely, the Block Distribution System, the Backup System, and the Water Distribution Control System that utilizes the former two systems. Figure.1 shows the concept of the water distribution management in Sendai Waterworks.

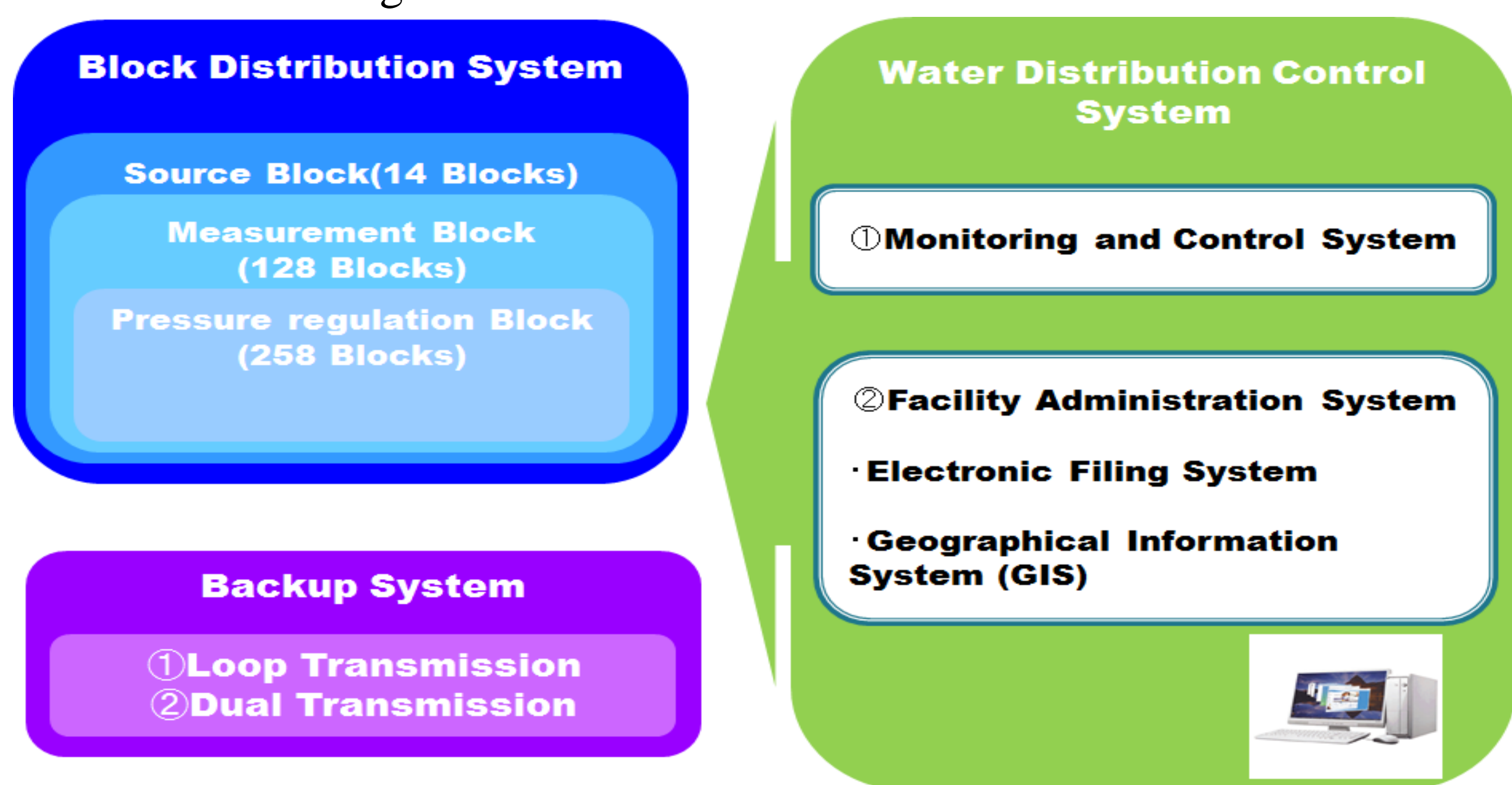


Figure 1: Concept of the Water Distribution Management

In terms of systems, we have developed a water distribution control system consisting of a supervisory control system and a facility administration system. The supervisory control system plays a dynamic role and serves two functions. The first is continuous monitoring of water flow from intake to distribution as well as facilities condition. The second is remote-controlling water pressure and volume between distribution mains as needed. Information on facilities and water distribution conditions are visualized via an information network. The facility administration system plays a static role and maintains a database of information on water facilities from pipelines to water meters that can be retrieved by a GIS-based electronic filing system.

In order for the water management system to adequately exercise these functions, there must be coordination between infrastructure and systems. The infrastructure we have in place is as follows (Fig. 2):

- A block distribution system that manages quantity of flow and pressure by block
- A dual transmission system and a looped distribution main that provide backup functionality

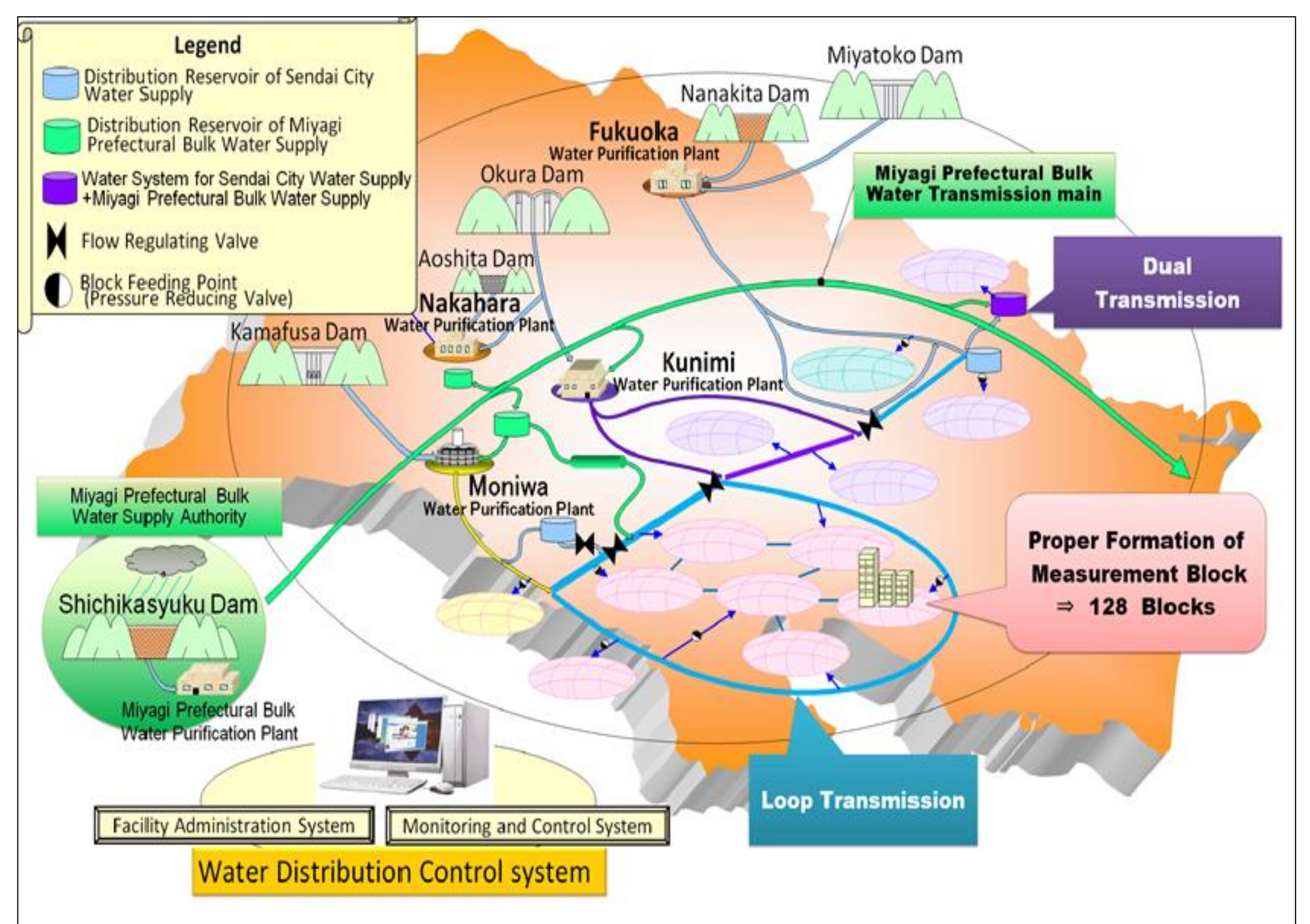


Figure 2: Schematic over view of the Water Distribution Management

Results & Discussion

In the Great East Japan Earthquake, there was no major damage to Sendai City's purification plants or distribution reservoirs, but the transmission main of the Miyagi Prefectural Bulk Water Supply broke.

The water supply to Sendai City was cut off, resulting in suspension of service to a maximum of 230,000 households, or 50% of water service users in the city.

However, by using these systems, we were able to work flexibly and efficiently towards an early recovery.

These systems provided for the minimization and limitation of the area influenced by the disaster, and contributed greatly to speeding up recovery work.

We show two concrete examples below.

1) In city center blocks, we switched the intake route using the looped distribution main (Fig. 3). In this way, we avoided suspension of service to blocks with a high concentration of facilities important for recovery, including the Prefectural Office and City Hall.

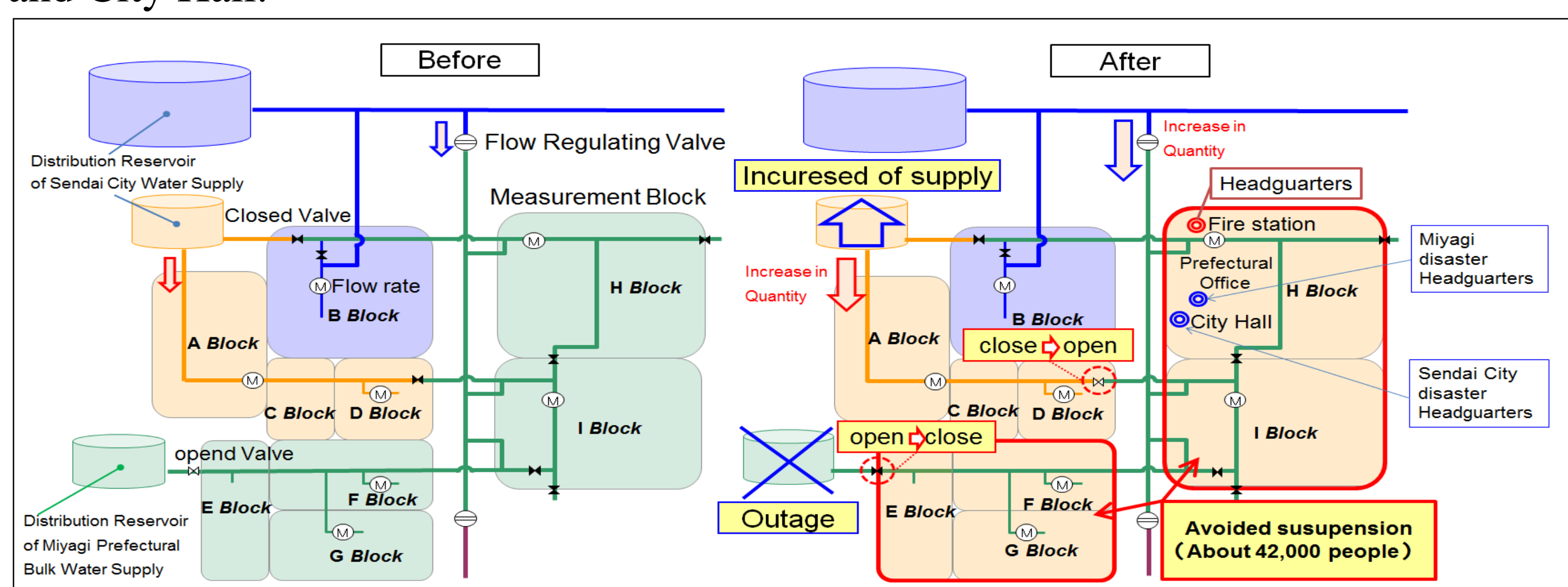


Figure 3: Avoidance of water suspension by Loop Transmission

2) When the water from the Miyagi Prefectural Bulk Water Supply was cut off, reservoirs in the dual transmission system were able to adjust and take in more water from our water purification plant (Fig. 4). Because of this, their period of suspension of service was reduced by up to 15 days compared to distribution reservoirs that only took in water from the Prefectural Water Supply.

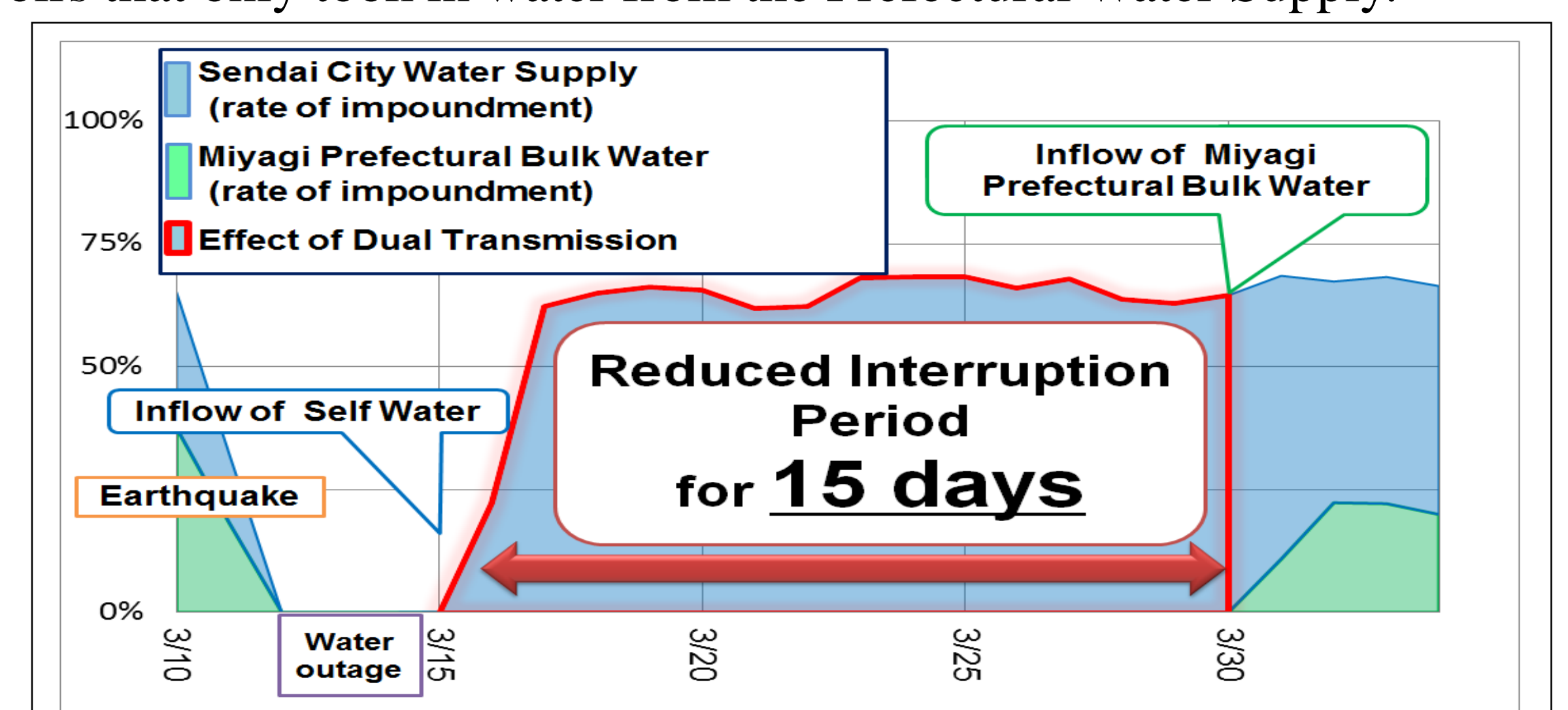


Figure 4: Shorten the Interruption Period with the Dual Transmission Effects

Conclusions

In this paper, we described Sendai City's water management system, and reported examples in which that system was used in the process of recovery from the Great East Japan Earthquake. In addition, based on the knowledge we gained from our experiences in the disaster, we described a disaster-resistant comprehensive water management system capable of avoiding or reducing large-scale suspensions of service and quick recovery. The future will be to advance a damage analysis with the age of the land reclamation and a fill part, and it's being utilized for damage prediction.

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