

The Effectiveness of the Dispatch of Support Staff to Small Waterworks

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ABSTRACT

After the Great East Japan Earthquake of 2011, technical support for damaged waterworks was focused on the major waterworks while the small waterworks did not receive sufficient support. The Niigata City Waterworks Bureau was asked to support such small waterworks and it dispatched one pipeline engineer to the town of Shichigahama (population 20,000) for four months.

The water distribution system of Shichigahama and the main supply pipe of the Enterprise Bureau in the Miyagi district were seriously damaged by the earthquake. The water supply system had to be shut down and was repaired within a month with the exception of the components in the lowlands that were damaged by the tsunami. In the reconstruction plan, the town of Shichigahama decided to relocate people living in tsunami-damaged communities to hilly regions, which do not face the danger of tsunamis. Thus, essential utilities, including a water supply, are urgently required in these new residential areas.

The dispatched staff engaged in the following work:

1. Supporting normal routine work
2. Carrying out tasks related to disaster-recovery
3. Managing the model project in Shichigahama

In particular, the preparation of the documents to apply for government subsidies was time-consuming. Furthermore, the waterworks reconstruction plan had to be repeatedly changed in response to the town's changing urban plan.

The dispatch of the engineer enabled Shichigahama to participate in a model project by the Ministry of Health, Labour and Welfare. With financial and technical support, the town of Shichigahama prepared an efficient waterworks reconstruction plan. The dispatched engineer brought valuable experience to the city of Niigata: before the dispatch, none of the staff in Niigata City Waterworks Bureau had experience in the design of a pipeline reconstruction plan but the knowledge gained through this experience will help prepare Niigata for future earthquakes and tsunamis. Further, during the project, the engineer took on a range of responsibilities and gained knowledge and skills through the experience.

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INTRODUCTION

This paper reports on the dispatch of technical support staff to Shichigahama following the Great East Japan Earthquake (GEJE) of 2011.

Further, in July 2017, an interview survey in Shichigahama and with several waterworks entities was conducted.

1.THE DAMAGE IN SHICHIGAHAMA BY THE GEJE OF 2011

1-1. Characteristics of the GEJE of 2011

The specifications of the GEJE of 2011 are shown in the Table 1.

Table 1. The 2011 GEJE off the Pacific coast of Tohoku [1]

Date and time	2011/3/11 14:46
Maximum seismic intensity	7 (JMA* Seismic Intensity) at the Miyagi prefecture north
Moment magnitude	9.0 (moment magnitude)
Hypocenter	38°6'12N 142°51'36E 24km deep
Epicenter	offshore from Sanriku
Maximum tsunami height	15 m high

*JMA: Japan Meteorological Agency

1-2. The town of Shichigahama and the Damage Caused by the GEJE

Table 2 and Figure1 show the characteristics of Shichigahama and the damage to the town caused by the GEJE.

Table 2. Characteristics of Shichigahama [2][3]

Location	East of Sendai, center of the Miyagi prefecture
Geography	Peninsula; the center of the town is elevated and the topography slopes downward to the coast.
Population	Approximately 20,000 (in 2011)
Maximum seismic intensity	5+ (JMA seismic intensity)
Maximum tsunami height	12.1 m, flooding 30% of the town.
Number of deaths	94 (directly by the earthquake or tsunami) +3 (indirectly relating to the disaster)
Number of damaged houses	674 completely destroyed, 237 more than half destroyed, 413 half destroyed , and 2,603 partially destroyed



Figure 1. Location of the town of Shichigahama

1-3. The Effects of the Tsunami on Shichigahama

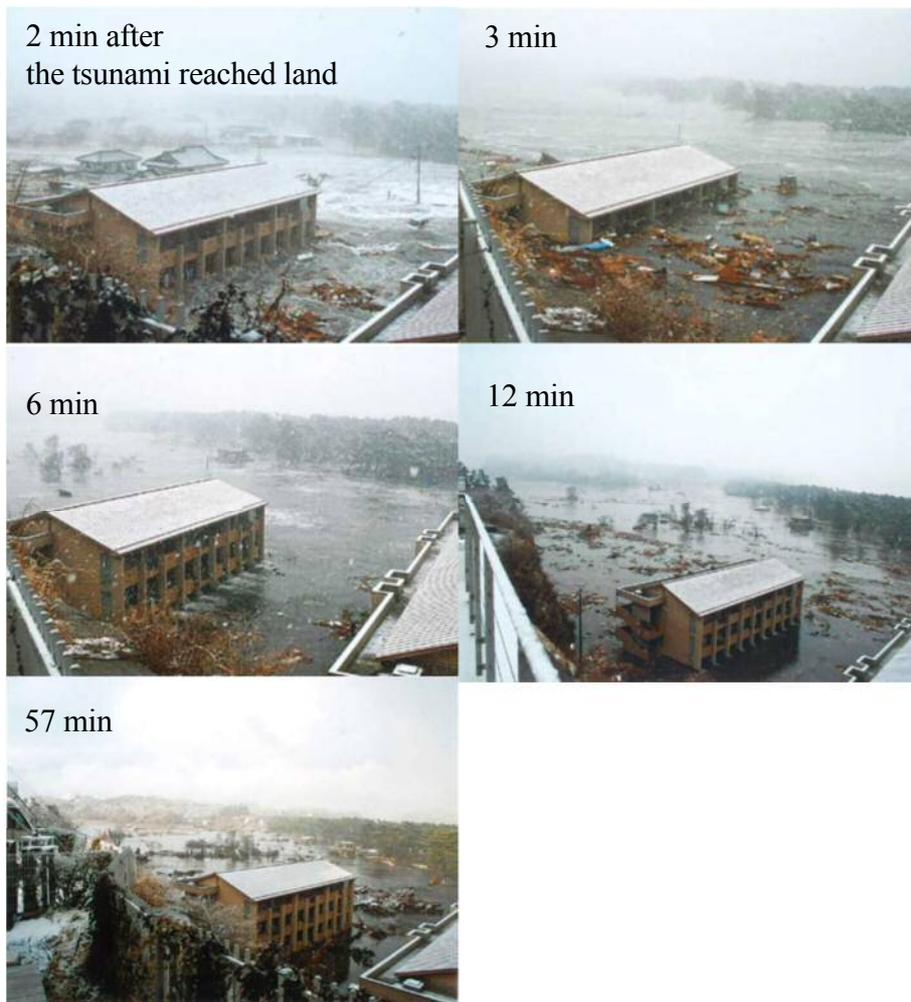
The earthquake damage was not serious in Shichigahama but its lowland areas were hit by a huge tsunami. The tsunami caused significant loss of life and damage to the infrastructure such as the waterworks. Figure 2 depicts the area hit by the tsunami. Picture 1 and Picture 2 show the impacts of the tsunami.



Figure 2. Flooded area due to the tsunami[4]
(the black arrow denotes the angle of Picture 1.)



Picture 1. Aerial photo of Shichigahama
(a few days after tsunami)



Picture 2. The town of Shichigahama after being hit by the tsunami

1-4. Shichigahama Waterworks

Table 3 shows the specifications of the Shichigahama waterworks immediately before the GEJE. The water-supplied population decreased by 5% after the GEJE.

Table 3. Specifications of the waterworks in Shichigahama[3]

Water-supplied area	13.27 km ²
Population in water-supplied area	20,743
Planned population for water supply	22,500
Adoption rate	100%
Water supply capacity	9,000m ³ /day
Purification method	Does not have its own purification plant; water is received from the Enterprise Bureau in Miyagi and Sendai City
Maximum daily water supply	5,913 m ³ /day
Average daily water supply	5,203 m ³ /day
Number of staff	1 technical staff member and 4 clerical staffs members

The Shichigahama waterworks does not have its own purification plant and therefore depends on a supply of water from other waterworks entities, Sendai City and the Enterprise Bureau in Miyagi into the Kimigaoka distribution tank. (In Japan, municipalities are mandated to manage their water supply on their own so municipalities usually have their own purification plants. In case a municipality without its own purification plant, like Shichigahama, the municipality buys water from other waterworks entities.) Figure 3 shows Shichigahama's water distribution system.

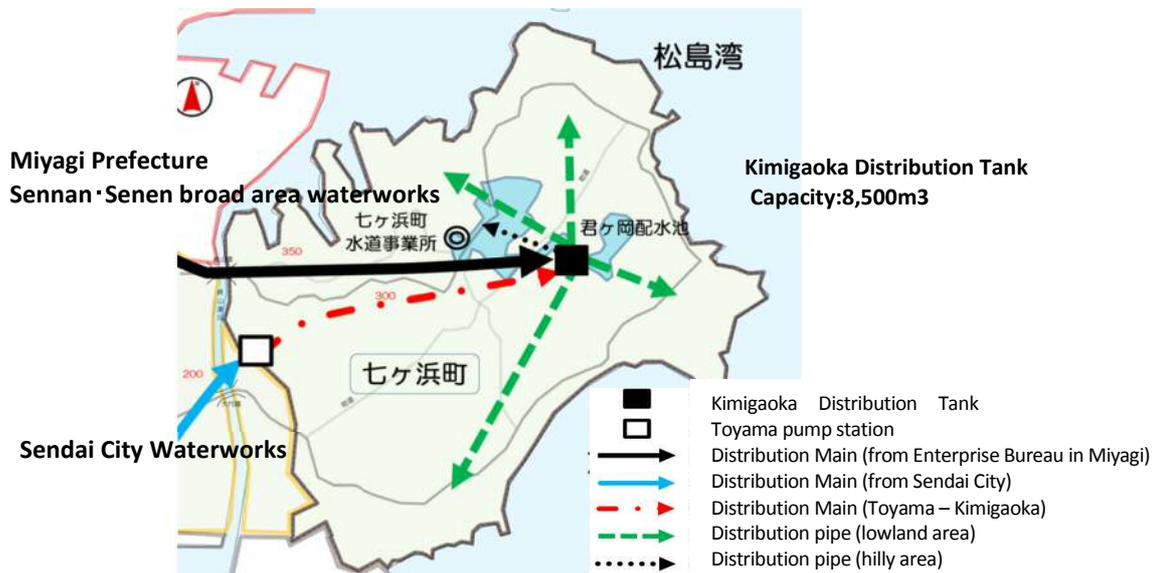


Figure 3. The distribution system in Shichigahama

The town of Shichigahama had limited human resource compared with the city of Niigata, as shown in Table 4.

A small waterworks entity with a small staff like Shichigahama is not rare in Japan as this human resources shortage is becoming a problem. The Japanese government recommends wide-area waterworks or the use of the private sector as an answer for this challenge.

Table 4. Scale of the waterworks in the town of Shichigahama compared with that in the city of Niigata

	Niigata City Waterworks Bureau		Shichigahama Waterworks
Maximum daily water supply	300,000 m ³ /day	⇔(1/50)	5,900 m ³ /day
Water supply population	Approximately 800,000	⇔(1/40)	Approximately 21,000
Number of staff members	360 (260 technical, 100 clerical in 2017)	⇔(1/70)	5 (2 technical, 3 clerical in 2017)

1-5. Damage to Shichigahama's Waterworks caused by the GEJE

As previously explained, as Shichigahama does not have its own purification plant, its waterworks was completely cut off when the distribution main pipe from Enterprise Bureau in Miyagi was broken by the earthquake. The distribution pipes in Shichigahama were also damaged by the earthquake. In particular, the air valve and the water pipe bridge were severely damaged in the coastal area. It took 35 days to fix the water failure in the distribution main from the Enterprise Bureau in Miyagi but the coastal area remained out of service because there were no houses remaining to service.

2. DISPATCH OF SUPPORT STAFF FROM THE CITY OF NIIGATA TO THE TOWN OF SHICHIGAHAMA

2-1. How and Why Niigata Dispatched Staff

In Japan, waterworks recovery support during major disasters has been done systematically based on the rule of the Japan Water Works Association (JWWA). The JWWA consists of waterworks entities all over Japan. After major disasters, prefecture leaders and district leaders managing other waterworks entities provide support to the damaged entity.

However, after the GEJE, the city of Sendai, which was the Tohoku district leader, and the Ishinomaki Water Supply Enterprise, which was the Miyagi prefecture leader, were also damaged. Therefore neither of these entities were capable of supporting other waterworks entities. This was one of the reasons that the recovery of small waterworks entities was delayed.

Because of this situation, the Japanese government created "The Liaison Council for Supporting the Restoration of the Water Supply Affected by the Great East Japan Earthquake" in July 2011. The council managed to match support entities with supported entities in a manner which was different from the conventional way.

To conduct this matching, the council surveyed the needs for recovery support, revealing that there were manpower shortages within small waterworks entities. Thus, the council requested the large waterworks entities dispatch support staff to such small waterworks entities.

2-2. The Dispatched Staff

The dispatched staff was selected to have technical capabilities in construction control and pipe maintenance as well as the ability to provide psychological support. At that time, there was only one young staff member eligible to be responsible for the waterworks in Shichigahama.

The profile of the dispatched staff member is as follows:

Age: 40 (in 2011)

Profession: civil engineer

Post: technical staff chief (in 2011)

Career: worked as a waterworks pipeline engineer for 17 years

(12 years as a construction project manager and 5 years in pipeline maintenance;
in middle of his career, he also worked in sewerage for 3 years)

During the dispatch, the staff member's affiliation remained the Niigata City Waterworks Bureau.

Below is a comment provided in an interview with the dispatched staff member about his feelings at the time.

"After I started my career, there were some major disasters. I was chosen as a dispatched staff member several times, but I couldn't go. After the GEJE, my family was willing to send me and I was able to go without hesitation. I have thank to my family and my co-workers."

His section chief provided the following comment:

"Truthfully, it was very tough to send him, as he was an ace in my section. It was difficult to redistribute the responsibilities with my section. However, we were willing to send him because it was our way of support to the area impacted by the disaster. All of his co-workers worked hard in his absence."

2-3.Work of the Dispatched Staff

After disasters, waterworks entities are very busy with particular tasks such as the recovery of the waterworks system, preparing documents to apply for subsidies, etc. Thus, the dispatched staff member engaged in the following work:

•*Supporting routine work*

He assisted with normal routine work such as water-quality test, responding to inquiries, checking water leaks, etc.

•*Carrying out tasks related to disaster recovery*

The costs for disaster recovery can be subsidized by the government. The preparation of the documents for applying for such government subsidies was a time-consuming process.

Additionally, several meetings with other agencies were held to coordinate views and schedules of construction projects.

•*Managing the model project in Shichigahama*

The town of Shichigahama recognized that a waterworks reconstruction plan should be made as quickly as possible but it was difficult to form the plan because there was a shortage of manpower. With the support of dispatched staff, it became possible to engage in the model project run by Ministry of Health, Labour and Welfare (MHLW), which helped to form the plan as quickly as possible.



Picture 3. Dispatched staff working at the office, on site, and in a meeting

3. WATERWORKS RECONSTRUCTION MODEL PROJECT BY MHLW

Every waterworks planning project is the responsibility of that waterworks entity, and waterworks reconstruction planning is not an exception. Therefore, the government cannot help with planning directly. However, the waterworks reconstruction model project run by the MHLW is a new support scheme which had not been tested before the GEJE. With this project, the government is able to support impacted districts in an indirect way. This model project facilitates consideration of how the reconstruction of waterworks should be done in the afflicted areas.

For this project, 12 districts were chosen as the models and the following policies were implemented.

- Facilities were constructed in accordance with the town's urban reconstruction plan.
- Adequate stability of facilities and the water supply against seismic activity was ensured.
- Facilities were designed while considering the cost in the future.

Some waterworks entities offered the following reactions to the model project.

"We were concerned that it would take a lot of time to participate, so we did not request to join the project."

"The model project itself seems to be useful, but we were nervous that the project might require follow-up research."

Although no entity executed the model project in its original form, the deliverables of the model project were utilized as the bases of the reconstruction plans.

In the model project, the town of Shichigahama focused on the hydrological estimation in hilly areas by considering the collective relocation of the residents from coasts areas. Applying the model project make the reconstruction of the town very smooth compared to the reconstruction efforts of other waterworks entities as shown by Picture 4 and Picture 5.



Picture 4. Shichigahama public housing in 2011, 2013, and 2017(from left to right)



Picture 5. Shobuta-hama beach(south area of Shichigahama) in 2011, 2013, and 2017(from left to right)

4. CONCLUSION

• *Supporting the needs of small waterworks entities*

Through our experience in supporting disaster-affected waterworks, the needed support time and scale can be described as follows:

→Large waterworks entities require large-scale, short-time-span support.

→Small waterworks entities require small-scale, long-time-span support.

According to the interviews conducted with the affected entities about the staff dispatched for long periods of time, a long-time continuous single dispatched staff member is desirable. Dispatched staffs mainly handle construction work and damaged waterworks entities hope that dispatched staff members will take care a construction project from the beginning through the end. But dispatching one staff member continuously is tough on the staff member, his family, and his office co-workers.

Countermeasures for these challenges include taking enough takeover period or remaining on site through the completion of the work. In the case of Shichigahama and Niigata, the dispatched staff member remained at the dispatched office for 4 months and he followed up continuously thereafter via e-mail, telephone, and short-term visits. In this way, he could complete his task successfully.

• *Characteristic waterworks reconstruction in an area impacted by a tsunami*

If an area impacted by a tsunami, structures such as houses completely collapsed. Therefore, urban design standards must be reviewed and the waterworks reconstruction must be adjusted accordingly.

In the survey conducted in July 2017, it was widely reported that coordinating the schedules of related projects is difficult as there are several projects being executed by several entities in the same place. Therefore, it is ideal for a single entity to take the initiative and control the project.

Further, once water source is damaged by a tsunami, it may take a long time to be operational once again. Thus, some affected entities recommend securing multiple or tsunami-resistant water resources. For example, Shichigahama, which is receiving water from Sendai City and the Enterprise Bureau in Miyagi, is considering increasing the percentage of water received from Sendai in case their waterworks are again cut off due to another disaster.

5. REFERENCES

- [1]: Ministry of Health, Labour and Welfare(MHLW) . 2014. “Final report of GEJE waterworks facilities damage situation research”
- [2]:Shichigahama Town. 2014. “GEJE Shichigahama Town disaster record”
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- [4]:Tsunami Damage Mapping Team, Association of Japanese Geographers. 2011. “The Maps of the Area hit by the Tsunami of 11 March 2011, Northeast Japan ”