



Towards the Sustainable Waterworks Facilities for the National Capital of Japan: Implementation of the “Tokyo Waterworks Main Facilities Renewal Program”



Makoto Kakinuma

Director, Engineering Guidance Section, Coordination Division, Tama Waterworks Reform Promotion Center, Bureau of waterworks, Tokyo Metropolitan Government
6-7 Midorimachi, Tachikawa-city, Tokyo, 190-0014

INTRODUCTION

In Japan, the coverage of water supply now reaches about 98% and people can always drink safe tap water from taps. However, the existing waterworks facilities including water purification plants (WPPs) and pipelines are getting old, and the utilities in Japan are having a major challenge of renewing these aging waterworks facilities.

On the other hand, a variety of risks such as damages to the waterworks facilities caused by earthquakes and increasing storm rainfall and drought by climate change, which will affect the water services in the future, are expected.

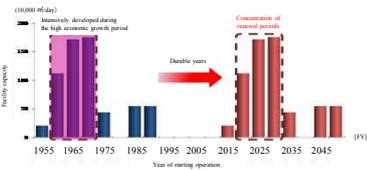
The Tokyo Waterworks formulated the “Basic Concept for Renewal of Tokyo Waterworks Facilities” in March 2012 aiming for the renewal of sustainable waterworks facilities which enable to sufficiently cope with risks which can occur in the future as well as apparent challenges.

In addition, we also formulated the “Master Plan for the Construction of Tokyo Waterworks Facilities” in February 2016 which summarizes the construction targets in the next 10 years such as renewal of WPPs in order to materialize such basic concept.

Furthermore, water conveyance facilities, WPPs, water transmission pipes and water supply stations play important roles as the main facilities forming the backbone of the waterworks facilities. We compiled the “Tokyo Waterworks Main Facilities Renewal Program” which provides the directions, effects and specific efforts toward the development of the main facilities to be implemented intensively in the future, and are aiming for more reliable water supply.

THE CHALLENGE OF THE TOKYO WATERWORKS: “VARIOUS RISKS, INCLUDING AGING WATERWORKS FACILITIES RENEWALS”

1 Aging Waterworks Facilities and Intensive Renewal Periods



【Figure 1】 Capacity of WPPs by construction year

- The Tokyo Waterworks developed and expanded intensively waterworks facilities during the high economic growth period of Japan. For this reason, a number of large-scale WPPs will be subject to their renewal at the same time from 2020. (Figure 1) Therefore, it is necessary to renew those WPPs systematically.

2 Threat of Natural Disasters



【Figure 2】 Damage example due to earthquake (Damage on a water tower)

- Learning from a lesson of the Great East Japan Earthquake in 2011 (Figure 2) that caused tremendous damages to the Tohoku Region, it is vital for the Tokyo Waterworks to improve the overall water supply capabilities to respond to natural disasters including readiness to so-called Tokyo Inland Earthquake, which imminence has been suggested.

3 Influence of Climate Change and Arrival of a Society of Possible Population Decrease

- The Tone River water system, which is a main water resource for Tokyo, is weak against impact of drought. In addition, severe drought and water quality deterioration has been predicted as the progress of future climate change.
- In addition, The population of Japan has been decreasing after its peak in 2008 and it is projected that the future population may decrease. Although the population of the Tokyo Metropolis has still continued to increase now, it is projected that its population will turn to decrease from the peak of 13.36 million people in 2020.

DIRECTIONS OF DEVELOPMENT

【Directions of Waterworks Main Facilities Renewal Program】

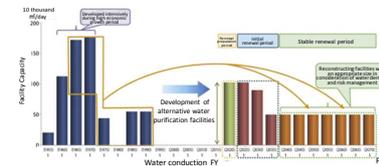
- The Tokyo Waterworks supplies tap water that is indispensable to the citizens and functions of the nation's capital of Tokyo by using the water supply system composed of many facilities.
- In particular, the water conveyance facilities, WPPs, water transmission pipes and water supply stations play important roles as the main facilities forming the backbone of waterworks facilities.
- In Tokyo, various risks such as the imminence of a large earthquake such as the Tokyo Inland Earthquake and the occurrence of other large-scale natural disasters are expected.
- However, we will respond properly so that a water outage may not occur in a wide area of Tokyo that may lead to a serious impact on the citizens and functions of the nation's capital of Tokyo, due to the occurrence of major failure in the main facilities.

【Main Efforts】

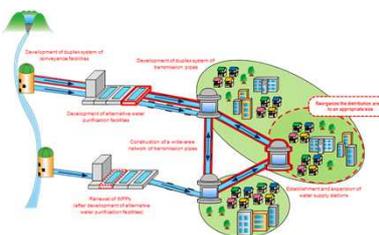
The development of these main facilities need enormous time and cost. Therefore, in renewal of WPPs, endeavoring leveling out of the operation volume by utilizing the asset management approach as well as developing alternative facilities, the Tokyo Waterworks will implement effective development, while securing reliable water supply under the appropriate operation and maintenance. (Figure 3)

The main efforts in the Main Facilities Renewal Program are shown as follows (Figure 4):

- (1) Development of duplex system of water conveyance facilities that cannot be stopped currently;
- (2) Systematic renewal of the WPPs and development of alternative WPPs that is equivalent to the deterioration in purification capacity during the renewal period;
- (3) Construction of a wider area network of transmission pipes and development of duplex system of transmission pipes that cannot be stopped currently; and
- (4) Establishment of new water supply stations and expansion of existing water supply stations at the time of renewal.



【Figure 3】 Development and renewal period for WPPs (Conceptual diagram)



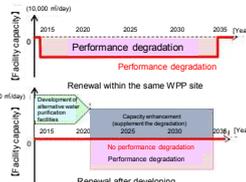
【Figure 4】 The Development According to the Tokyo Waterworks Main Facilities Renewal Program (Conceptual diagram)

SPECIFIC PROJECT EXAMPLES

Among main efforts, “Renewal of Water Purification Plants” and “Establishment and Expansion of Water Supply Stations” are dealt with. “Regarding “Duplexing of water conveyance facilities” and “Duplexing and networking of water transmission pipes”, please see another poster.

【Renewal of Water Purification Plants】

- After constructing alternative water purification facilities in other WPPs in advance that is equivalent to the deterioration of purification capacity in association with renewal, we will sequentially start renewal of WPPs. Furthermore, the order of renewal of WPPs will be decided in consideration of the evaluation of asset management. (Figure 5)
- Also, as drastic preventive measures to provide against risks such as volcanic eruption and terrorism which threaten people's living, we will cover water purification facilities concurrently with renewal of WPPs. (Figure 6)



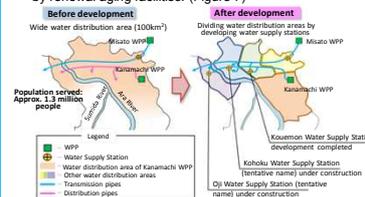
【Figure 5】 Effects or alternative water purification facility development (Conceptual diagram)



【Figure 6】 Covered water purification plant (Conceptual diagram)

【Establishment and Expansion of Water Supply Stations】

- Regarding the areas where distribution reservoir capacity is insufficient or the facilities which have a risk that water outage or muddy water extend over wide areas in case of emergency because water distribution areas where a WPP or a water supply station supplies tap water are expanding, water distribution areas will be reorganized into areas with an appropriate size, by construction of new water supply stations and enhancement by renewal aging facilities. (Figure 7)



【Figure 7】 Water supply station development in the eastern area of Tokyo (Conceptual diagram)



Completed Kouemon Water Supply Station

CONCLUSION

“AIMING FOR RENEWAL OF SUSTAINABLE WATERWORKS FACILITIES”

Utilizing the asset management, the Tokyo Waterworks will steadily promote the Main Facilities Renewal Program, under the efficient development of facilities and water supply operation. And furthermore we will flexibly and appropriately respond to various risks and challenges which affect the waterworks in the future and aim for sustainable waterworks facilities, as well as coping with the challenges such as earthquake resistant countermeasures and risk management before it is too late.

Also, it is essential to obtain the understanding and cooperation of many people involved including the citizens of Tokyo in order to smoothly promote renewal of main facilities. Therefore, we will widely disseminate the “Tokyo Waterworks Main Facilities Renewal Program” which summarizes the directions of main facility development, the effects of the development and specific efforts.

Furthermore, we will fulfill our mission to stably supply safe, tasty and high-quality water in the future including during the 2020 Tokyo Olympic and Paralympic Games, and hand over the top waterworks system in the world to the next generation, as well as supporting realization of “Tokyo, No.1 city in the world” as the most important lifeline.

We are sincerely looking forward to your visit to Tokyo at the IWA World Water Congress in Tokyo in 2018 and the 2020 Tokyo Olympic and Paralympic Games.

Reference Materials: [1] TMG Bureau of Waterworks; Basic Concept for Renewal of Tokyo Waterworks Facilities, March 2012, [2] TMG Bureau of Waterworks; Master Plan for Construction of Tokyo Waterworks Facilities, February 2016, [3] TMG Bureau of Waterworks; Tokyo Waterworks Main Facilities Renewal Program, March 2016