31. UTILIZATION OF TREATED WASTEWATER IN SAPPORO

Presenter

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ABSTRACT

The Sapporo Sewerage Bureau (SSB) operates 9 wastewater treatment plants. Tertiary treatment (rapid sand filtration) is introduced in case of necessity, to achieve and keep environmental water quality standards in public waters.
To utilize reclaimed (sand filtered + chlorine disinfected) water, SSB recycles it as landscaping water. Annual infection risk is evaluated around 10^{-2} on reference to the research results of Committee for Reclaimed Water Quality.
SSB recycles secondary effluent for melting snow as well.

KEYWORDS

utilization, reclaimed water, rapid sand filtration, chlorine disinfection, landscaping water, annual infection risk, secondary effluent, snow melting water

INTRODUCTION

Sapporo is the largest city in Hokkaido, Japan's northernmost island. In 1886, the Government of Hokkaido was established in Sapporo to provide leadership in politics, the economy and culture. Sapporo is now fifth largest city in Japan with a population of more than 1.8 million.

Sewage works in Sapporo began in full scale in 1926, when sewer pipes were installed for discharge of stormwater in the urban area. Environmental hygiene deteriorated with a sharp increase in population, and the river pollution progressed in 1950s. To solve these problems, an improvement and extension plan of the sewer system including wastewater treatment was developed in 1957. Extension work became active with the turning point of the Winter Olympics in 1972. The service population rate, which was under 20% in FY 1970, reached 99.3% in FY 2001, and most citizens are now using the sewer system.

Diffusion of the sewerage system also contributed to improvement in river water quality. The Toyohira River, which was once too contaminated for fish to live in, became clean enough for salmon to swim up from the sea.

SSB divides the city into 9 treatment areas, and has established a wastewater treatment plant (W.T.P) in each area to conduct sewage treatment.
The amount of sewage treated at the 9 W.T.Ps is 1,000 x 10^3 m^3 day (260 m.g.d.).

NECESSITY OF ADVANCED TREATMENT

One of the roles of the sewerage system is conservation of water quality in public waters. In the case of Sapporo, sewerage facilities discharge treated wastewater into small and medium-size rivers. Because the ratio of treated wastewater to river water is expected to increase with population growth in the future, advanced treatment is introduced to achieve and keep environmental water quality standards in public waters, as well as to utilize reclaimed water for exhausted rivers and other purposes. (Fig.1)

Operation of a rapid sand filtration (tertiary treatment) commenced in 1991 at the Soseigawa Treatment Plant as a water quality conservation measure for the Barato River, which is a closed water body. The treatment capacity of rapid sand filtration is 120 x 10^3 m^3 day (30 m.g.d.)

Advanced treatment will be further introduced in the future for wastewater treatment plants that require such treatment, while taking future river water quality fully into consideration.

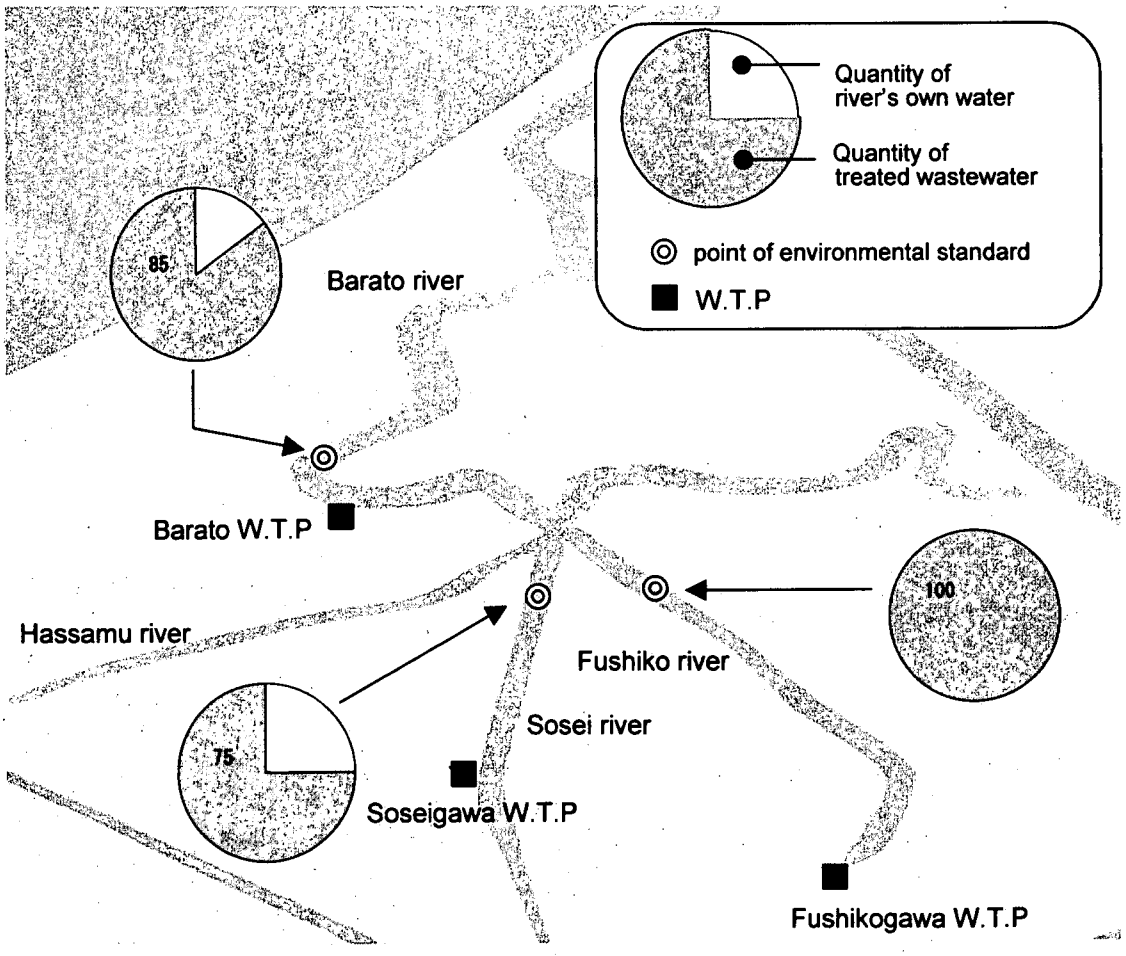


Fig.1 Treated wastewater ratio to river water

EXAMPLES OF UTILIZING TERTIARY EFFLUENT

Utilization for Landscaping Water

The Yasuharu River is a historic drainage channel excavated for turning wetland into farmland by farmer-soldiers who came to Hokkaido more than 100 years ago. The river was, however, exhausted as residential areas increased with the progress of urbanization. Under the theme of "promenade to remember the hardship of our ancestors," streams have been recovered since 1992 by introducing tertiary effluent from the Soseigawa Wastewater Treatment Plant, and afforestation and establishment of a promenade along the channel were promoted to add relaxation and comfort to the citizens' lives. (Fig.2 - 4)

Tertiary effluent has also been introduced to Tonden, Higashitonden and Barato Kohoku rivers since 1998 to recover clear streams and to utilize as water for extinguishing fires. (Fig.5)

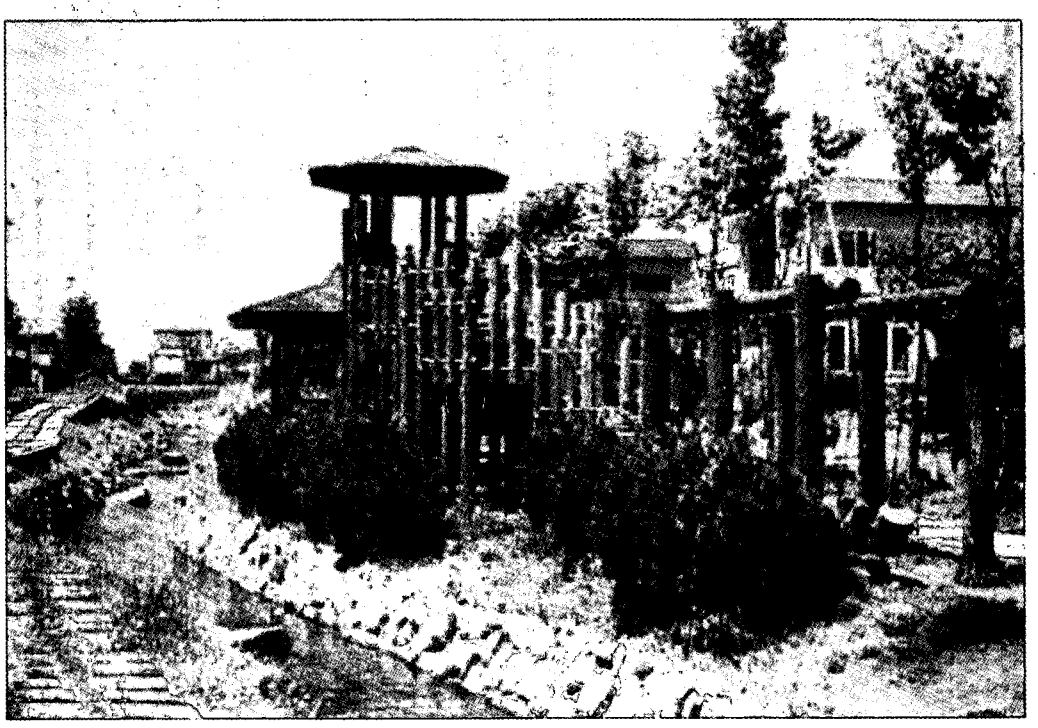


Fig.2 Yasuharu River after improvement

Fig.3 Spillway of reclaimed water (sand filtered + chlorine disinfected) to Yasuharu River

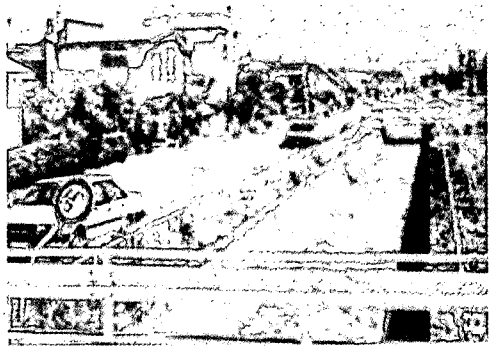
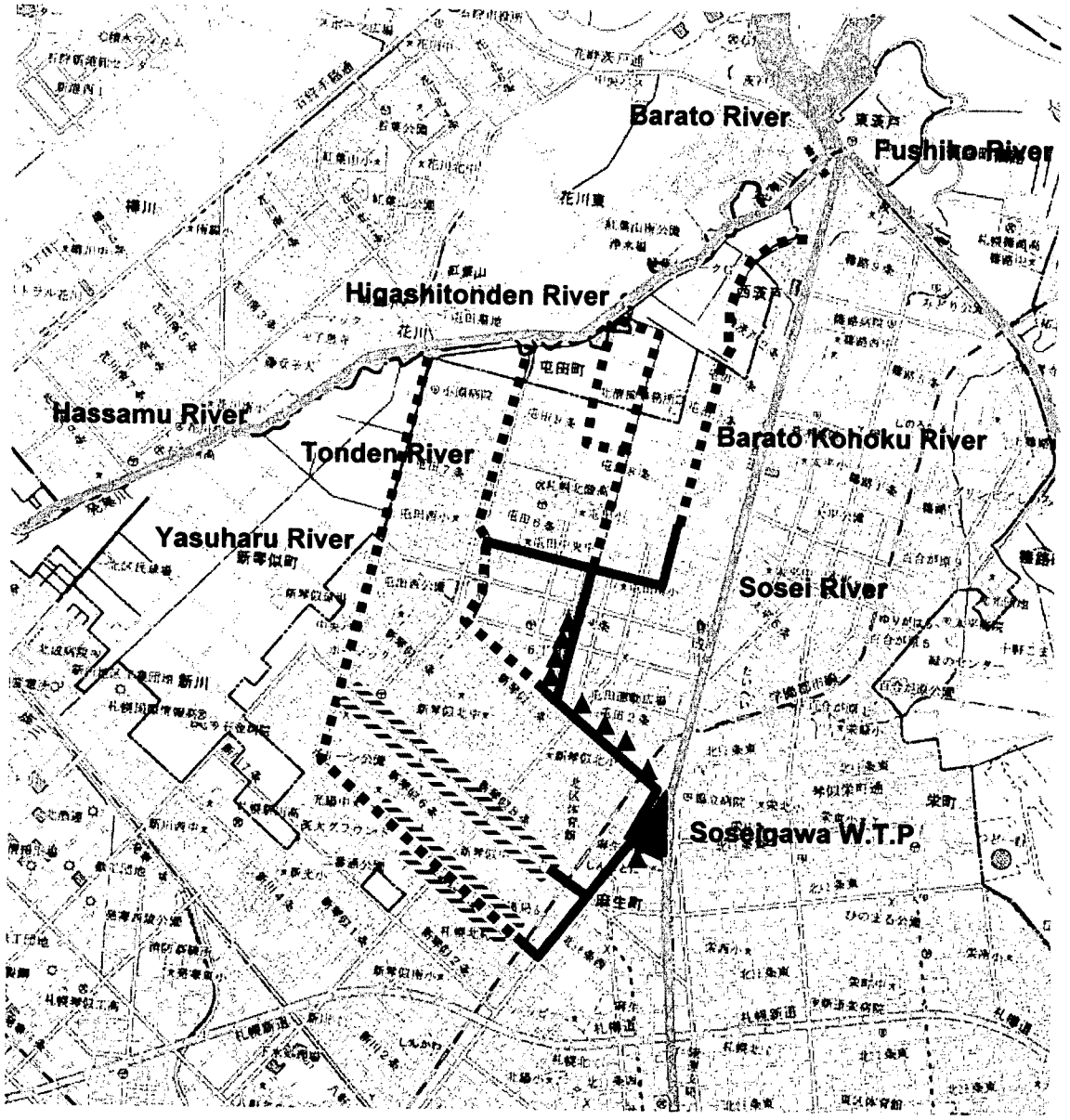


Fig.4 Yasuharu River before improvement



reference	
———	reclaimed water pipe
▪▪▪▪▪▪▪▪▪▪▪▪▪▪▪▪	river (reclaimed water)
▰▰▰▰▰▰▰▰▰▰▰▰▰▰▰	snow-flowing conduits
▲	underground fire hydrant

Fig.5 Utilization of reclaimed water

Annual Infection Risk of the **Yasuharu River**

Reclaimed water, sand filtered and chlorine disinfected at the Soseigawa Treatment Plant, is conveyed to the Yasuharu River by means of pump. Chlorine dosage at the Soseigawa Treatment Plant is less than 5 mg/l.

SSB takes samples from surface water in the Yasuharu River 2 times in a month from May to November, and analyzes the samples. Sample points are starting point and 600 m down point (the end of promenade area) in the Yasuharu River.

The results in August are shown in Table 1.

Table 1 Water quality of the Yasuharu River

		Starting Point			600 m Point		
		Aug. 9th 2001	Aug.23rd 2001	average	Aug. 9th 2001	Aug.23rd 2001	average
Residual chlorine (mg/l)	Total	1.1	0.5	0.8	0.3	0.2	0.3
	Free	0.7	0.2	0.5	0.1	0	0.08
C-BOD (mg/l)		0.1	0.8	0.7			—
Turbidity		0.7	1.7	1.2			—
Chromaticity		9.4	8.2	8.8			—
Odor		non	Slite smell of chlorine	—			—
Total Coliforms MF method		0	1	1			—
Total Coliforms per ml		0	6	3	10	26	18

blank: No data.

SSB surveyed enteric virus (Hep-2) in 1997 and in 1998. Table 2 shows the enteric virus (Hep-2) removal ratio and Fig.6 shows the enteric virus (Hep-2) concentrations of each sample.

Table 2 Enteric virus (Hep-2) removal ratio

Water Sample	Aug. 3rd.1998			Oct.27th.1997		
	Enteic virus conc. (MPN/l)	Removal Ratio (%)	Log Removal (log10)	Enteic virus conc. (MPN/l)	Removal Ratio (%)	Log Removal (log10)
W.P.T influent	1,743.5			262.6		
Secondary effluent	15.7			20.9		
Tertiary effluent (Sand filtration effluent)	4.1	96.8%	1.50	6.1	95.2%	1.32
[Chlorine Disinfection] 3 - 5 mg/l						
Starting Point of Yasuharu River	0.5			1.0		
600 m Point of Yasuharu River	1.0			0		

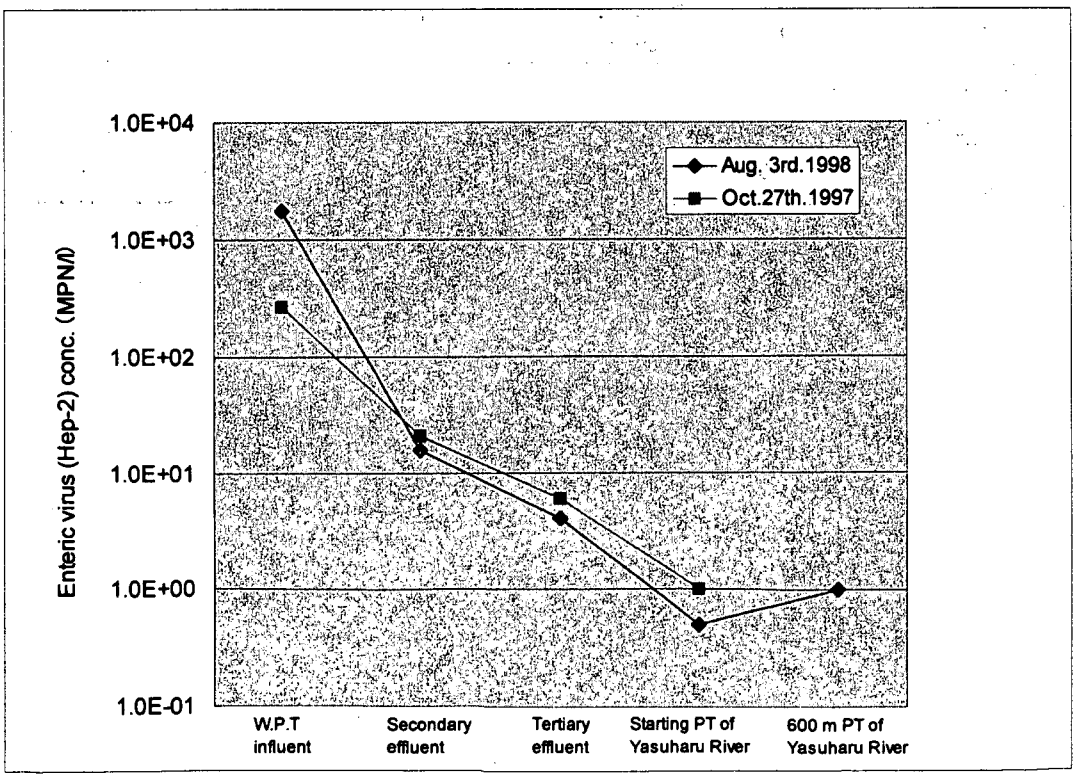


Fig.6 Enteric virus (Hep-2) concentrations in water samples

On reference to Fig.7 which is shown by Committee for Reclaimed Water Quality, the annual infection risk of the Yasuharu River is evaluated around 10^{-2}.

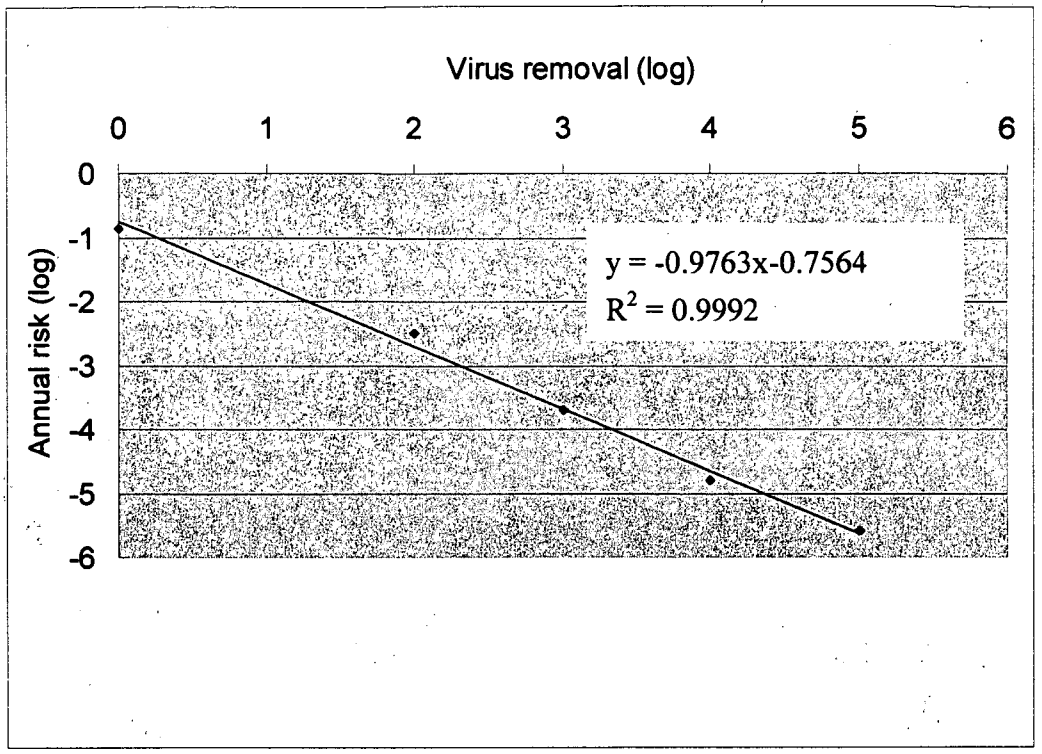


Fig.7 Relationship between virus removal efficiency and annual risk of infection
(Recreational pond or stream, possible to bathe feet and hands)

EXAMPLES OF UTILIZING SECONDARY EFFLUENT

Utilization for Snow Melting Water

The average accumulation of snow in Sapporo is 4.5 m. (Fig.8) As snow falling on an urban area makes the living space smaller and has great influence on urban activities, snow measures are becoming a serious issue.

The City of Sapporo has been promoting a variety of measures to solve snow problems. Snow measures using thermal energy of secondary effluent and sewerage facilities are playing important roles in such measures.

In the sewerage system, efforts are being made to establish facilities to send secondary effluent to snow-flowing conduits (Fig.5) and snow-melting tanks using sewerage facilities (Fig.9) and conduct other measures.

Fig.8 Sapporo in winter

Fig.9 Snow-melting tank using sewerage facilities

CONCLUSION

Sewerage functions have been improved for more than 70 years since the first sewerage plan was launched in 1926 to support the city from underground as part of urban infrastructure. Today, environmental problems have been attracting global attention. Under these circumstances, sewerage assumes a fundamental role in the water cycle.

We are committed to actively contributing to global environmental preservation and promoting sewerage projects (such as utilizing treated wastewater) under the guiding principles of leaving assets to future generations so that they can boast of their "comfortable city."