Sector Governance and Regulation for Nationwide Full Coverage of Water Supply Service

The Ministry of Health, Labour and Welfare; regulatory agency of water supply (August 12, 2016)

No. T1 Ver. 1

2. Purpose of Water Supply: Public Health

(1) Public Health Objective

Improving public health

- **Preventing water borne diseases**
- **Providing a hygienic environment**

Article 1

Purpose of the Act

Improving **public health and the living environment**

Article 2

Responsibilities of the National Government and local governments

Waterworks are indispensable **for the protection of human health**

2. Purpose of Water Supply: Public Health

(2) Water Quality and Facility Standards to Secure Public Health

Safeguarding public health

- **Drinking water quality standards**
- **Facility standards**

Article 4

Drinking water quality standards

- Absence of contaminants
  Pathogens, Toxic substances
- Free of excessive metal substances
  Copper, Iron, etc.

Article 5

Facility standards

- Location and arrangement for economical and easy practical operation and maintenance
- Structures and materials withstanding water pressure, earth pressure, seismic forces, etc.
- Free of water contamination and less leakage

3. Historical Path towards Nationwide Coverage

(1) Public Ownership

- 1890 Waterworks Ordinance
  → Water supply service by public ownership and responsibility
- 1946 The Constitution of Japan
  → Article 25 right to life clause → water supply for all
- 1957 Water Supply Act
  → Water supply for all including rural population
  → Large investment for Small Scale Public Water Supply in all municipalities

Article 25 of *the Constitution of Japan*

All people shall have the right to maintain the minimum standards of wholesome and cultured living. In all spheres of life, the State shall use its endeavors for the promotion and extension of social welfare and security, and of public health.

=

Goal 6 of SDGs;
Sustainable Development Goals

Ensure availability and sustainable management of water and sanitation for all.

3. Historical Path towards Nationwide Coverage

(3) Development of Small Waterworks in Rural Areas

Small scale water supply
by residents
in communities

→

Small Scale Public Water Supply
(population served 101-5000)
by municipal governments

Type	planned service population	Accounting system	Funding source	Location
Municipal Water Supply	≧5001	Public enterprise accounting system	(mainly) Bond floatation	Urban area
Small Scale Public Water Supply	101-5000	General account	National subsidy and Bond floatation	Rural area
Facility for Drinking Water Supply	≦100	Self-financing by local residents	Joint investment by users and communities	Rural area

3. Historical Path towards Nationwide Coverage

(3) Development of Small Waterworks in Rural Areas

Enforcement of the Water Supply Act

- Nationwide full coverage of water supply service
- National subsidy for small scale public water supply systems

Human resource development

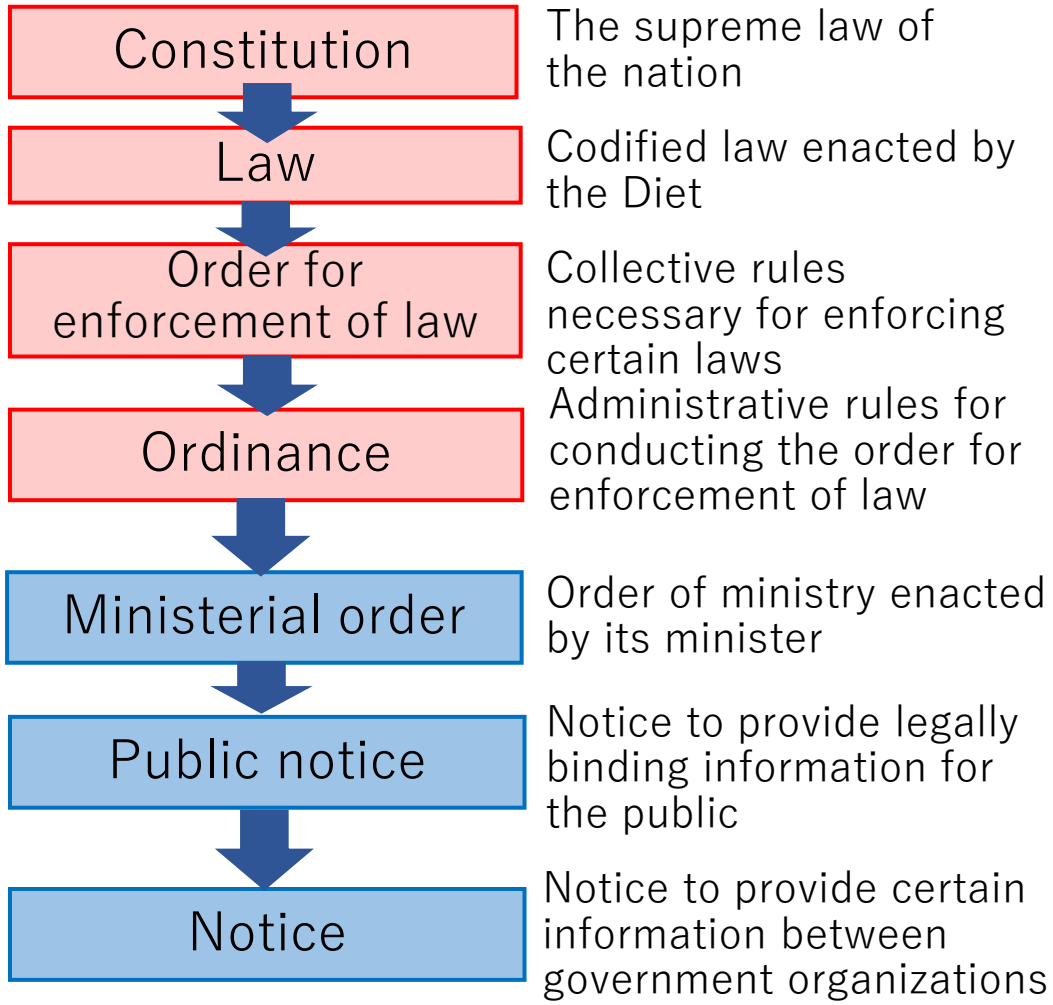
- Education for staff of prefectural governments
- They support planning and design of small scale public water supply

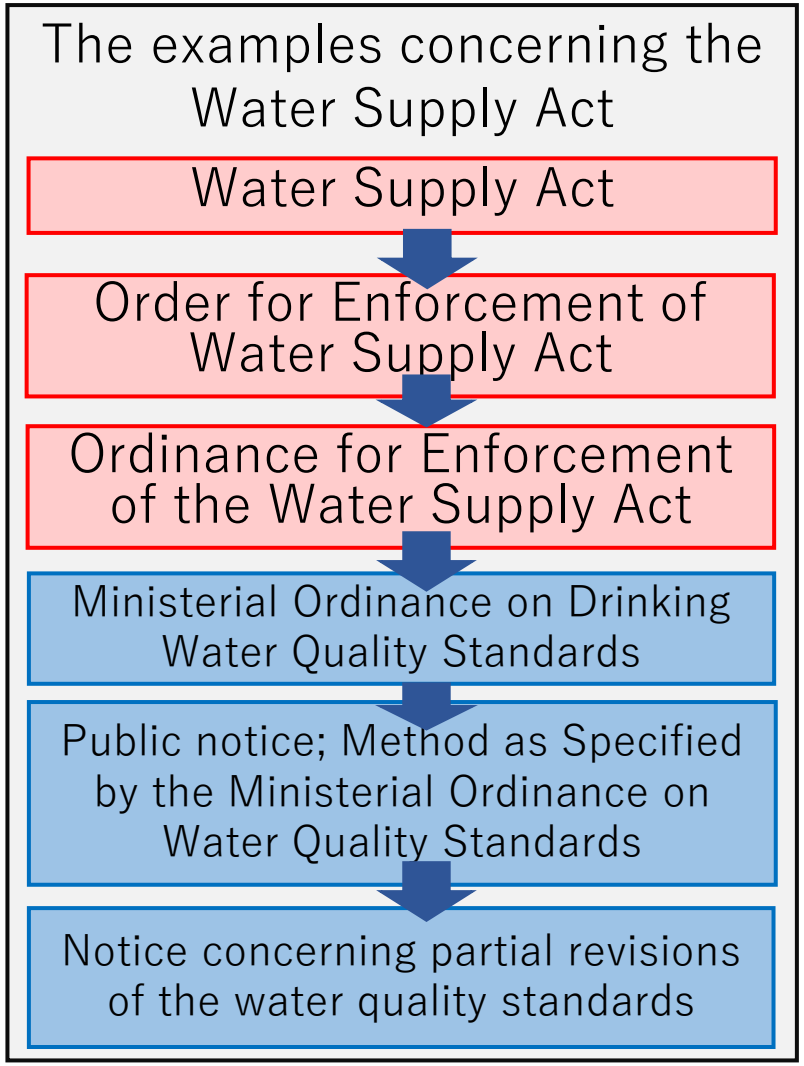
Leadership by mayors

- Promotion of water supply for improvement of living conditions in their villages
- Effective utilization of national subsidy

4. Regulatory Framework and Administration

(1) Legal System





4. Regulatory Framework and Administration

(2) Approval (License) System of the Waterworks

1890 Waterworks Ordinance
- Public ownership principle
- Approval(License)
- Safe water supply

1957 Water Supply Act
- Public ownership principle
- Approval(License)
- Safe water supply
- Water quality standards
- Water supply facility standards
- Technical administrator of waterworks

Approval(License) for waterworks
- **Special license** for waterworks issued by the national government (or the prefectural governor). Licensing aims to make sure operators are able to deliver a continuous, stable, safe and clean supply of water.
- Application for Approval (License) requires the following;
  - Water volume and water quality of source
  - Maps and drawings of water supply facilities
  - Total amount of construction expenses and their planned funding source ,
  - Construction period
  - Water tariff and management plan

4. Regulatory Framework and Administration

Information provided in the application for Approval(License) is basis for a master plan

(Project plan)

- Service area, population and water supply volume
- Outline of planned water supply facilities
- Planned date for start of water supply
- Construction expenses and finance
- Balance of income and expense
- Water tariff

(Construction design plan)

- Volumes of daily water supply
- Type of water sources and water intake points
- Capacity and quality of water resource
- Location of water supply facilities
- Water purification process
- Pressure of water distribution pipes
- Scheduled dates of commencement and completion for construction works

Attached documents;

- Evidence to explain reliability of raw water intake
- Location of water supply facilities
- Water source
- Layout plan, elevation, section and structural drawing for main water supply facilities
- Layout plan and longitudinal section for transmission and distribution pipelines

4. Regulatory Framework and Administration

Criteria for license
Article 8 of the Water Supply Act

Licensing of water supply services can be rejected, unless the application meets the following requirements:

- The commencement of water supply services is in accordance with the general demand of the community.
- The plan for the water supply services is certain and reasonable.
- Designs for construction of water supply facilities meet the Water Supply Facility Standard.
- The water supply service area does not overlap the service area of any other water suppliers.
- Water supply conditions meet requirements of articles of the Water Supply Act.
- In the case of water supply services applied by entities other than local public entities, there exists a certain financial foundation capable of performing the water supply services.
- The commencement of water supply services is required from a viewpoint of public interest.

4. Regulatory Framework and Administration

Waterworks Ordinance (1890)

- The first modern water supply system in Japan began supplying water in Yokohama city in 1887 and shortly thereafter in several other cities. Among these, some systems were installed privately and fell short of the facility standard or were poorly managed. Under these circumstances, the *Waterworks Ordinance* was promulgated in 1890.
- "Public ownership principle" and "Approval(License)" had been already defined in the *Waterworks Ordinance* and these concepts were further elaborated by the *Water Supply Act*.

Article 2: Municipalities may not install a water supply facility without public funds.

Article 3: Municipalities must provide a prospectus containing the following details through a prefectural governor to the Home Minister for Approval (License) to install a waterworks system.

Article 10: Anyone who has access to water supply services may request the mayor to test water quality and to check the volume.

4. Regulatory Framework and Administration

(3) Other Relevant Laws

In addition to the Water Supply Act, some related acts supporting waterworks play an important role in operating waterworks and constructing facilities.

Water Supply Act

Local Public Enterprise Act
- Principle of **Cost Recovery**

Essential rule for continuous management of water utility

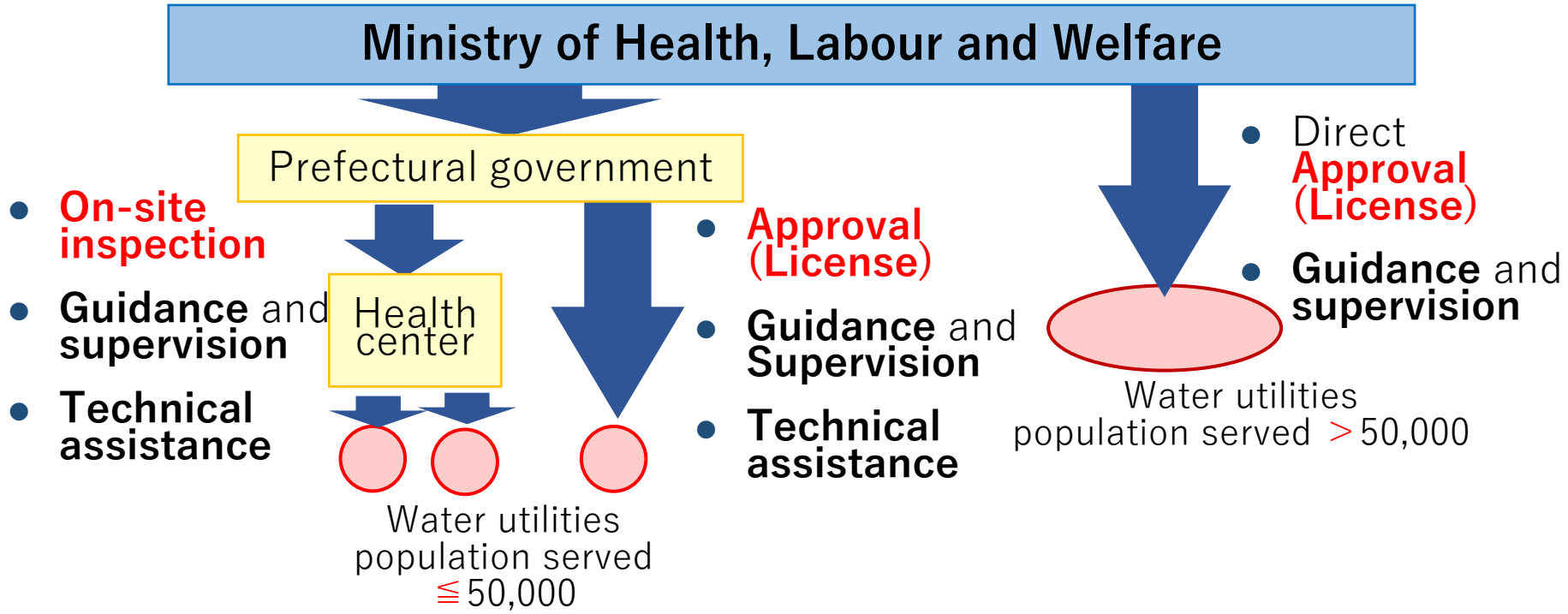
Measurement Act
- **Approval of meter types** and **inspection** to ensure accuracy
- **Replacement in 8 years**

River Act
- **License for use** of river water
- **Authorization for intake facilities**

4. Regulatory Framework and Administration

(4) Administrative Framework

- Detailed rules of the Water Supply Act
  → Order for Enforcement of Water Supply Act,
  Ordinance for Enforcement of the Water Supply Act
- Administrative guidance for rational execution of law is conducted as necessary based upon ministerial order, public notice and public notice of the Ministry of Health, Labour and Welfare, etc.

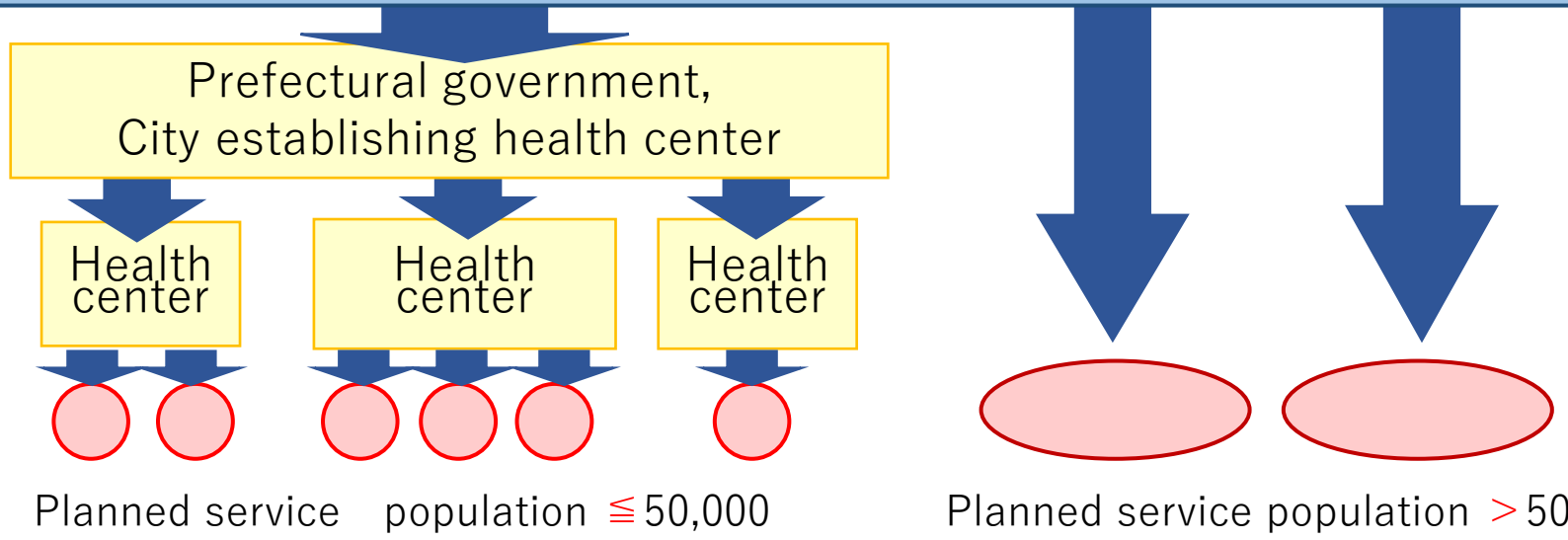


4. Regulatory Framework and Administration

Japanese Administrative System for Water Supply

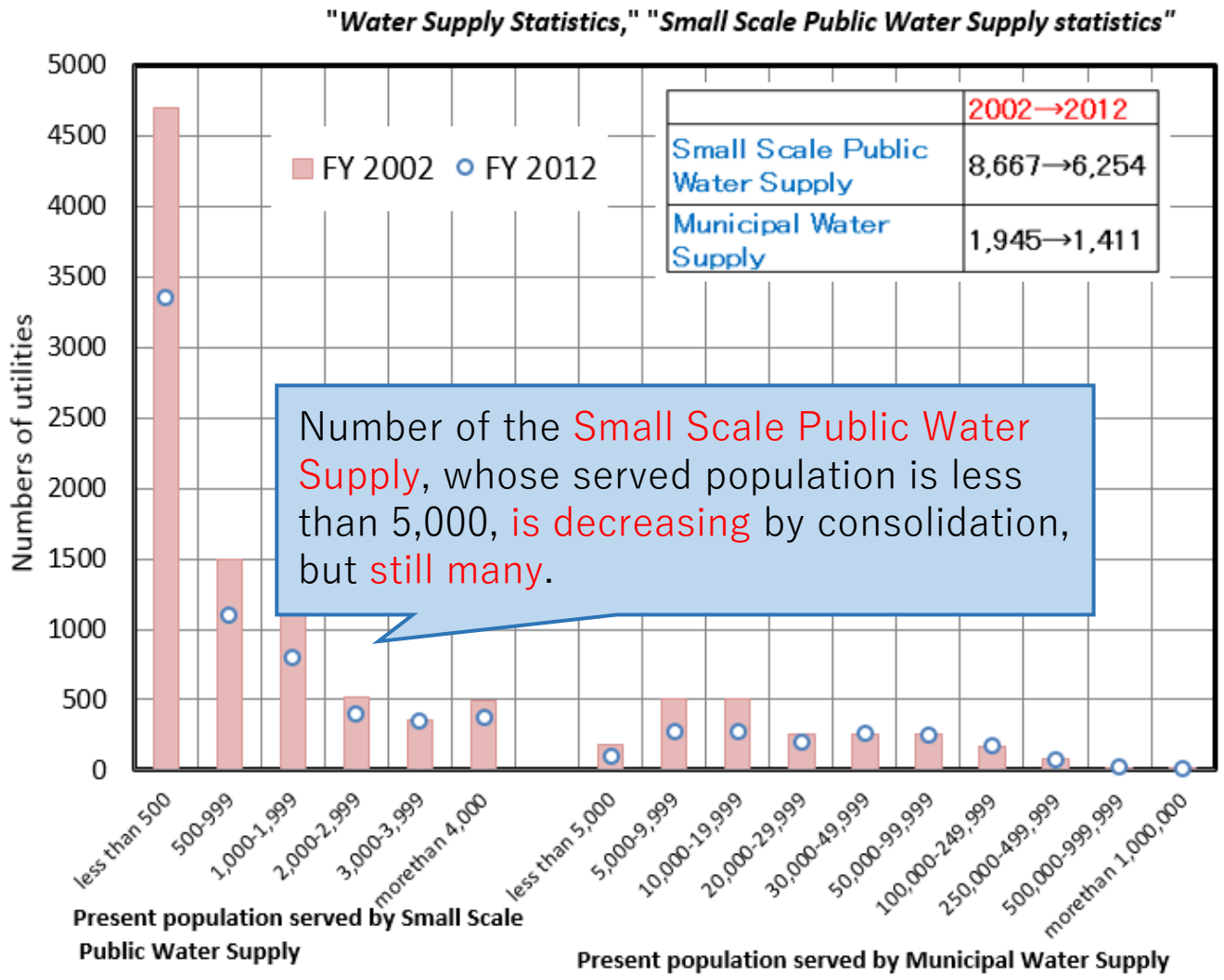
National Government:
the Water Supply Division of the Ministry of Health, Labour & Welfare

Ministerial order：Ministerial ordinance on Drinking Water Quality Standards (Order of the Ministry of Health, Labour and Welfare No. 101 of May 30, 2003)
Public notice：Concerning partial amendment of the ministerial order which specifies technical standards for water supply facilities (April 8, 2008)



Health center: An organization established based upon the Community Health Act
Ensures comprehensive promotion of regional public health measures

5.Challenges in Maintaining Universal Coverage



Numbers of water utilities according to population served (FY2002→FY2012)

5.Challenges in Maintaining Universal Coverage

Challenges Specific to Smaller Utilities

Water Supply Development with slogan "Nationwide full coverage of water supply service" in Japan.

Small and medium scale public water supply utilities contributed to progress of water supply coverage.

Small and medium scale public water supply utilities have problems concerning renewal, maintenance and management, etc.

Measures for solving problems

Planning of Water Supply Vision	Planning of Water Safety Plan	Asset management	Promotion of consolidation of water utilities
Making of a master plan	Ensuring continuity of safe water supply	Correct recognition of current situation	Consolidation with water supply utilities in adjacent areas

Water Supply System:
from Water Sources to Distribution

**Amagasaki Water Treatment Plant,
Hanshin Water Supply Authority**

No. T2 Ver. 1

2. Water Sources and Treatment System

It is better to select clean and safe water sources without microbial contamination.

Water source from mountain stream

Quantity

Meteorological water (rain water)

Spring water, stream water, groundwater

Need to prevent microbial contamination.

Surface water from dam reservoirs and rivers

Plentiful but contaminated

River water has been used in response to increased water demand.

4. Treatment Process

(1)Chlorination

Chlorination is the most effective disinfection method for the drinking water supply.

The effectiveness of chlorination was recognized as countermeasure against deteriorated public health in Japan after World War II .

Chlorination has prevented waterborne diseases, which were caused by contamination of water sources.

Advantages

- Very effective against waterborne diseases
- Reliable disinfection
- Easy to operate
- Simple injection device
- Low cost

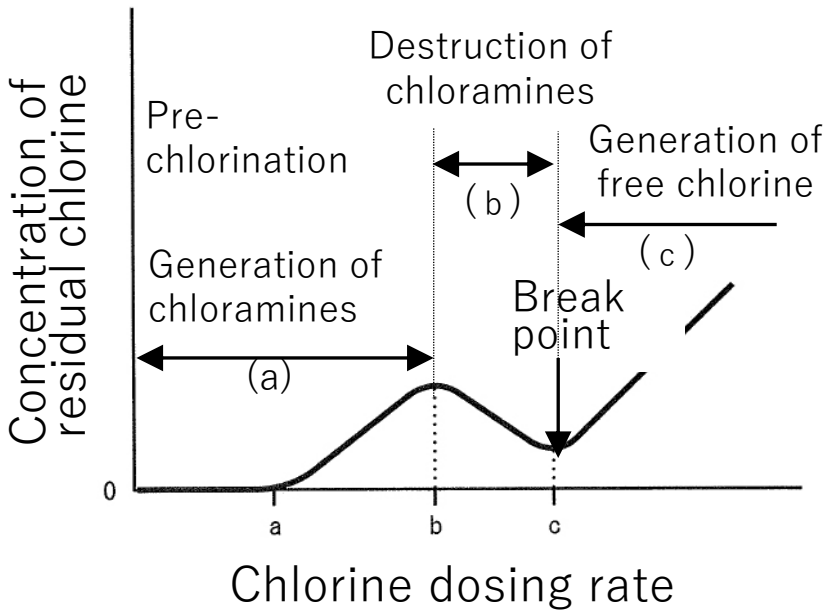
Disadvantages

- Toxicity
- Generation of disinfection by-products
- Corrosion of equipment
- Over-reliance on chlorination may lead to neglect of water purification technology

4. Treatment Process

Water Treatment Using Chlorine

Ammonia Removal (Break point chlorination)



Source: Ministry of the Environment, Government of Japan, http://www.env.go.jp/hourei/05/000188.html

Pre-chlorination to remove algae and ammonia(a)

Generation of chloramines (a)

Destruction of chloramines (b)

Break point chlorination
High injection rate to reduce the chloramine generate free chlorine (c)

Manganese Removal

Oxidation of manganese by chlorine

Rapid and certain removal by filtration of manganese sand, which has manganese dioxide coating.

4. Treatment Process

The Standards of Chloride Concentration

After the World War II, GHQ prescribed the chlorine dosing rate based on their experiences in a developing country.

Residual chlorine at tap; 2.0 mg/l

It was too high in Japan, where hygiene conditions were rather well-maintained.

Bringing in the precedents without considering local situation

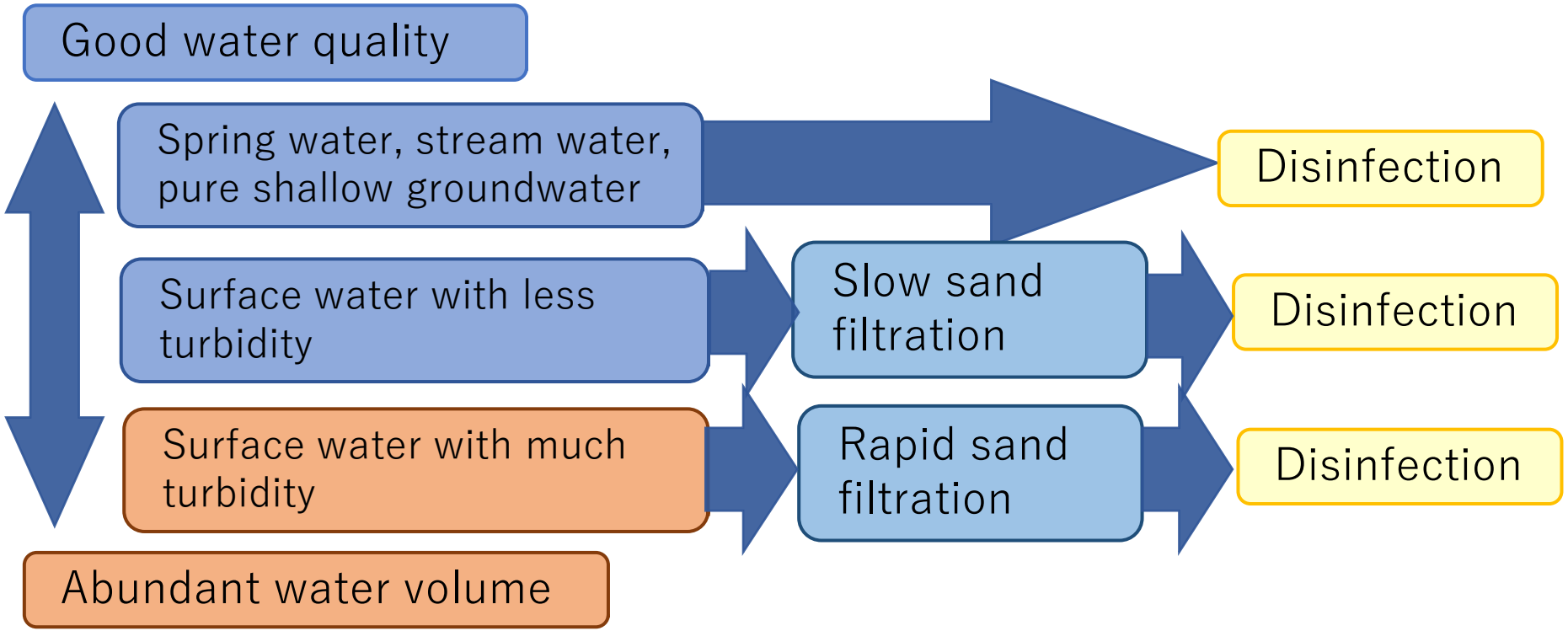
After independence, the Japanese government reduced the chlorine dosing rate.

Free residual chlorine at tap; 0.1 mg/l
Combined residual chlorine ; 0.4 mg/l

4. Treatment Process

(2) Selection of Treatment Process

Water treatment facilities play a central role in water supply systems and its performance has a direct impact on the quality of the water supplied.



4. Treatment Process

(3) Slow Sand Filtration

Slow sand filtration is suitable for relatively clean raw water.

It provides biological treatment when water passes through a gelatinous layer (or biofilm) which consists of algae and bacteria, etc.

Gravity settling in sedimentation tank

↓

sand filtration with filtration velocity 4 – 5 m/day (Japanese standards)

↓

chlorination

Advantages

- Simple facilities
- Less chemicals and electricity
- Removal of odor

Yanagasaki water treatment plant, Otsu City Public Enterprise Bureau

Source: Otsu city Public Enterprise Bureau, *Main water supply facilities* http://www.city.otsu.lg.jp/kigyo/about/water/1454032216393.html

4. Treatment Process

(4) Rapid Sand Filtration

In the early days of construction of water supply systems in Japan, slow sand filtration was selected for treatment of small volumes of relatively clean raw water. In response to the increasing demand, coagulation, sedimentation, and rapid sand filtration became the mainstream treatment technology.

Economic growth caused a huge water demand

↓

Intake points were moved downstream to get larger water volumes

↓

High in contaminants and high turbidity

Advantages of RS filtration

- Adjusts to changes in turbidity
- Less space for facility
- Removal of highly concentrated ammonia

The first plant using rapid sand filtration in Japan(Keage WTP, Kyoto City)

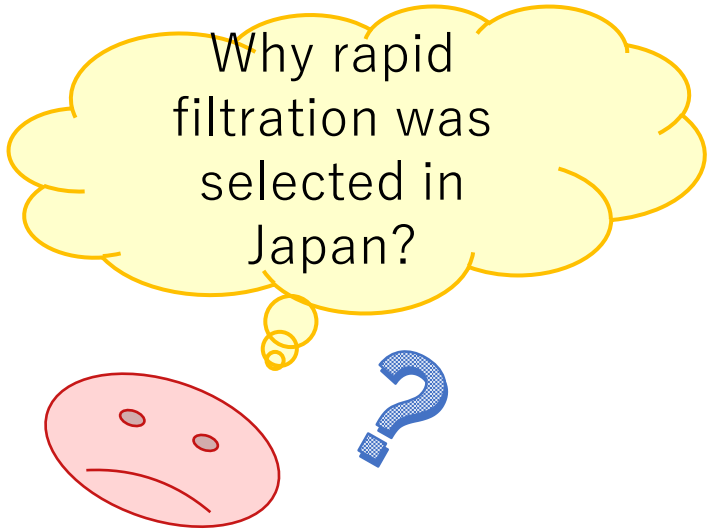
4. Treatment Process

The Background of Widespread Application of Rapid Filtration

Smaller footprint than slow sand filters, making it possible to built in a small plots.

Disruption of river bed caused by digging for construction materials.

Increased levels of ammonia in source waters due to contamination beyond the ability of slow sand filtration.



It may be only a trend; it was the most advanced technology at that time.

4. Treatment Process

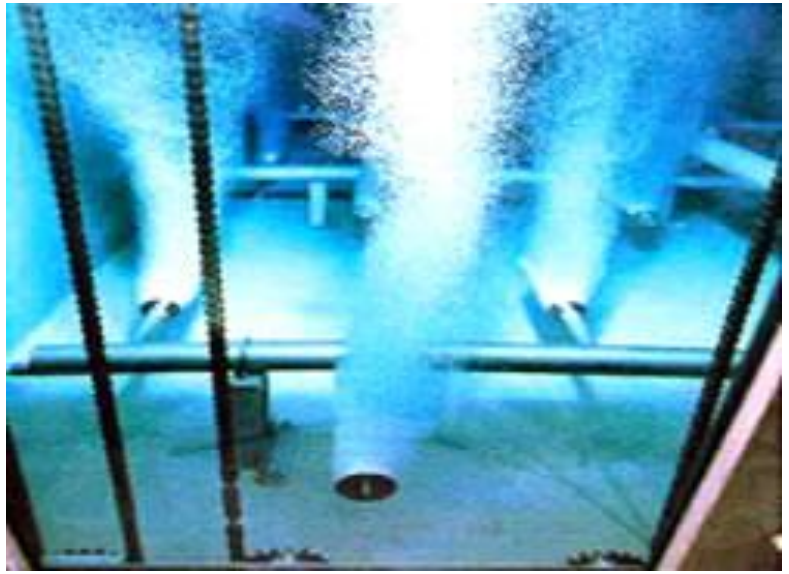
(5) Advanced Water Treatment

Exacerbating pollution of source waters has reached to the levels that made it difficult to treat source waters by conventional water treatment processes designed for the removal of turbidity and disinfection. Japan has carried out a series of studies for the combination of various water treatment technologies to develop advanced water treatment technologies.

Ozonation
=Oxidize organic matter

Activated carbon adsorption
=Biological reactor

Removal of odor and organic substances improves drinking water quality.



Ozone contact basin

Tokyo Metropolitan Government Bureau of Waterworks：
https://www.waterworks.metro.tokyo.jp/suigen/topic/13.html

4. Treatment Process

(6) Membrane Filtration

Advantages of membrane filtration technology requires less land areas, low maintenance and minimal manpower because it is easy to control automatically.

The use of membrane filtration is expected to increase around the world in the future.

1994-1996 MAC 21 research project; Industry-government-academia collaboration

Membrane filtration technology continues to be developed.

Membrane filtration facilities, Water supply system for Kuroda area in Kyoto city, Waterworks Bureau, City of Kyoto

http://www.city.kyoto.lg.jp/suido/page/0000160981.html

5. Groundwater Use and Prevention of Land Subsidence

(1) Groundwater Withdrawal

In general, groundwater is clear and suitable as a drinking water source.
But in some cases, it requires treatment to meet water quality guidelines.

Check water quality carefully because some groundwater is not good for drinking water.

Contaminated by Fe, Mg, As…or *E. Coli.*

Maintain and monitor the well regularly.

Groundwater source
(Takizawa Village, Iwate Prefecture)

6. Distribution Systems

(1) Distribution Systems

The investment in distribution infrastructure such as service reservoirs, pump stations and pipelines is very costly and it accounts for 2/3 of the total capital cost of all the water supply facilities. Therefore, good planning of the distribution system based on the long-term perspective is very important.

Elevated tank,
Hachinohe Region Water Supply Authority

For good planning,

- Construct service reservoirs in high places
- Use elevated tanks when there is no suitable high place
- Plan the capacity of service reservoirs and distribution network based on the long-term water demand projection
- Understand pump technology and water hammer pressure to prevent critical damages to the system

6. Distribution Systems

(2) Pipeline Configuration

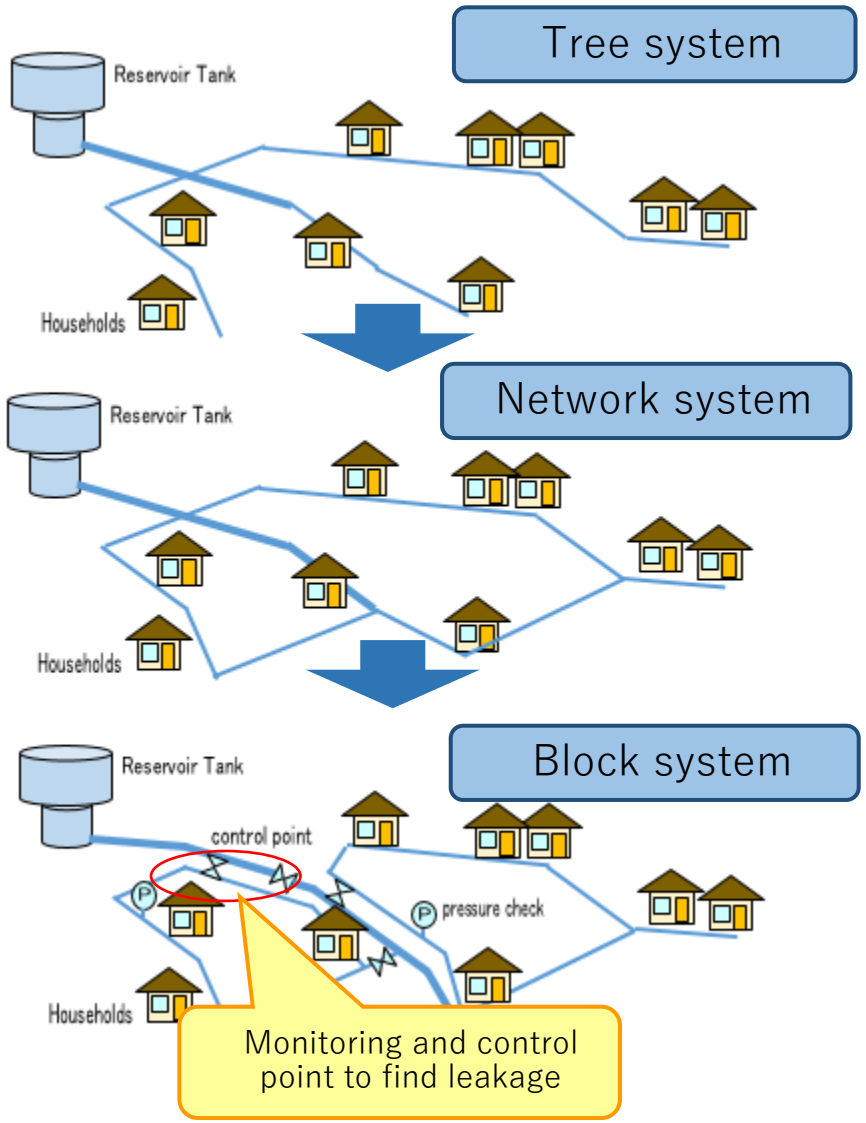
The planning policy for distribution pipelines has been changing gradually in Japan, from simple distribution to more sophisticated control of water distribution.

- 1st stage: Tree (dendritic) system for simple distribution
- 2nd stage: Network system to minimize the negative impact of accidents and ensure operational flexibility
- 3rd stage: Block system for

(1) optimizing water pressure

(2) clear picture of water supply operation

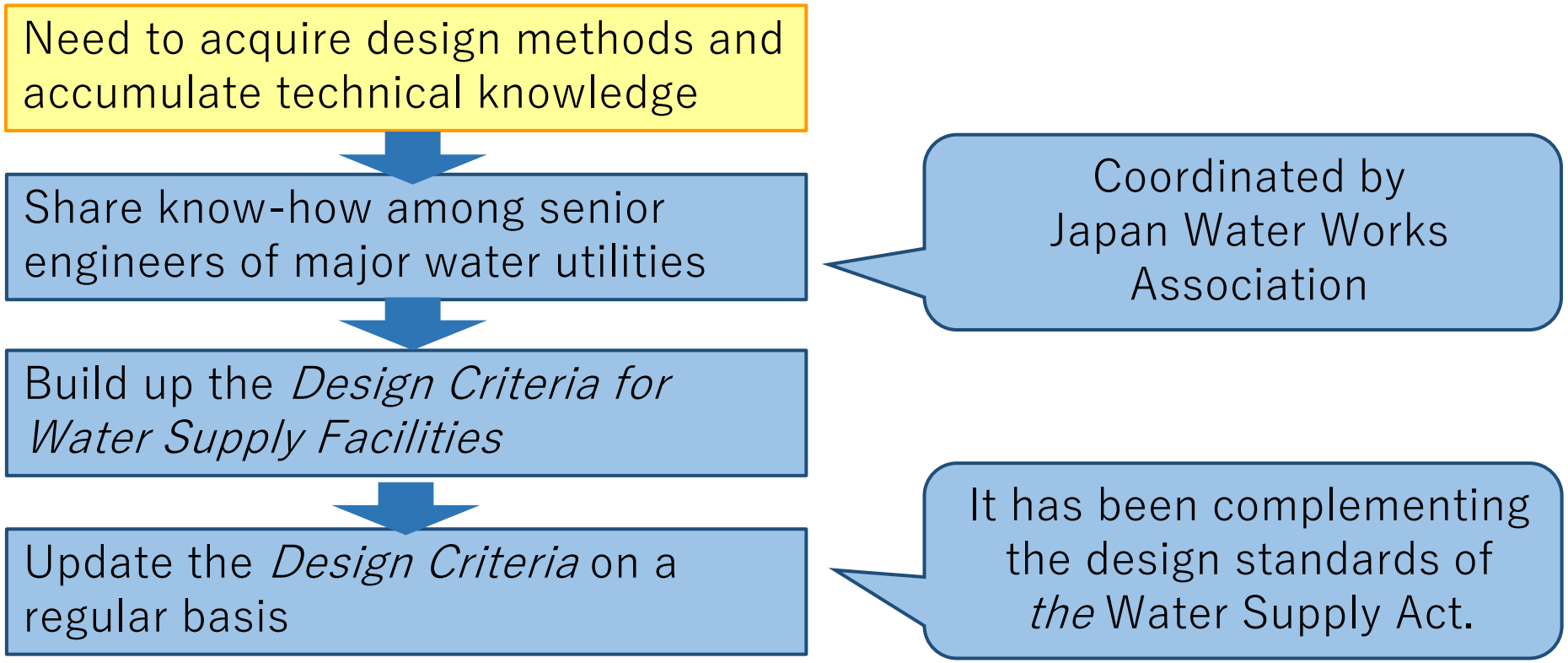
(3) identification of accidental damage and provision of backup water supply



7. Engineering Design and Master Plans

(1) Importance of Facility Standards

The most important concept for water supply is to secure the safe supply of water through well-designed water facilities. The design standards to define the function and capacity of water facilities are specified in *the Water Supply Act*.



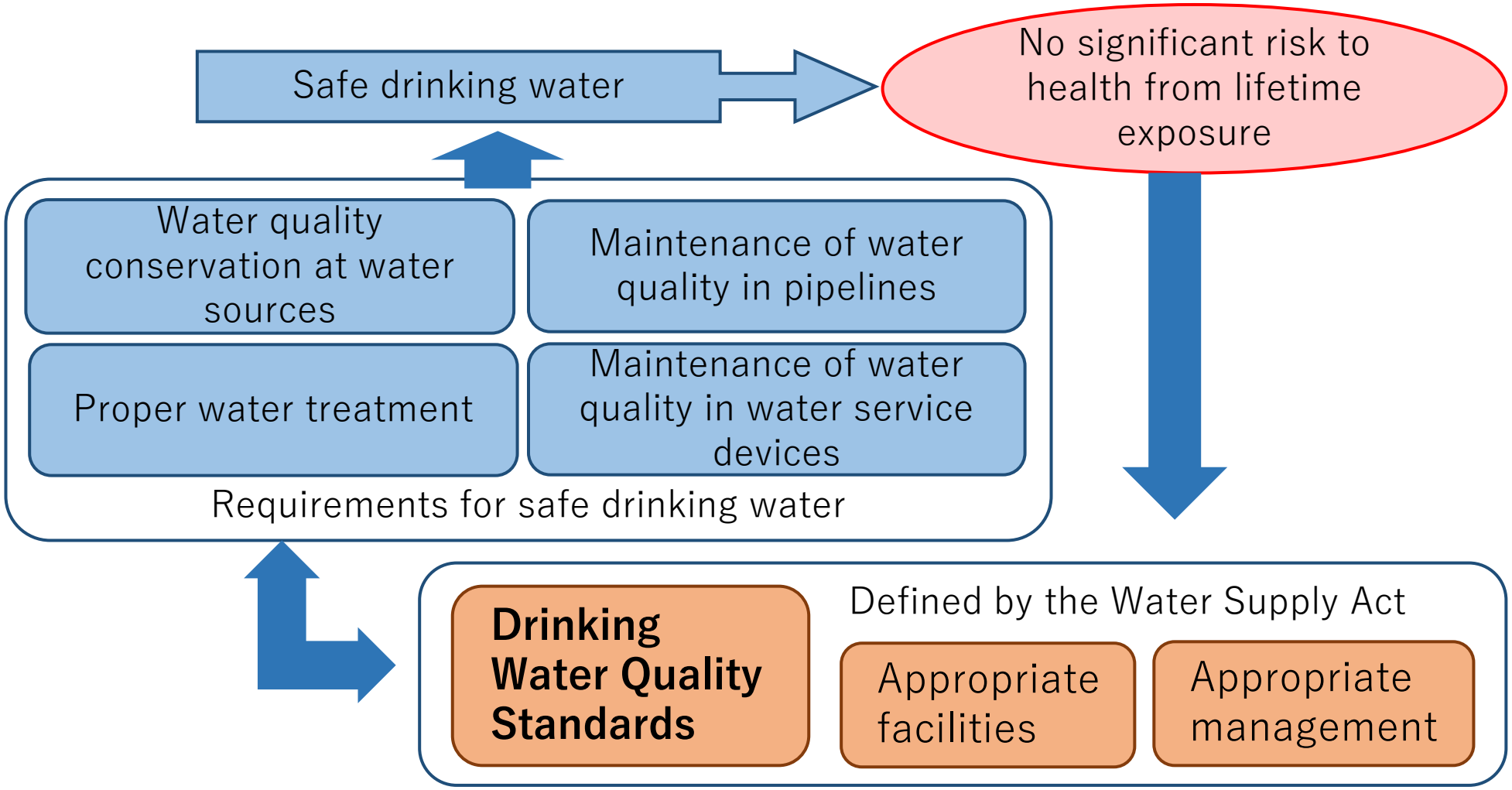
Water Quality Management

Water quality laboratory at Kitachiba Water Supply Authority (September 21, 2011)

No. T3 Ver. 1

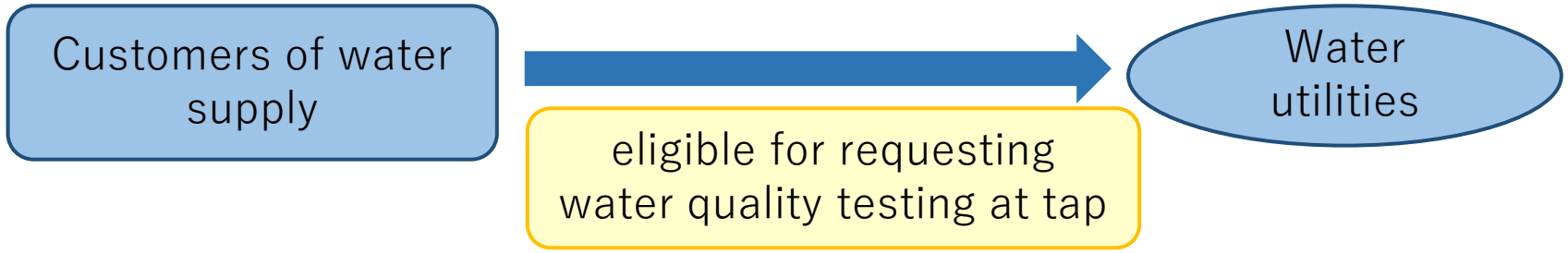
2. Importance of Water Quality Management

(1) History and Background of Water Quality Management



2. Importance of Water Quality Management

Column: Article 18 of the Water Supply Act



Emphasis on epidemiological safety of water supply

- Water Supply Act
- Drinking Water Quality Standards

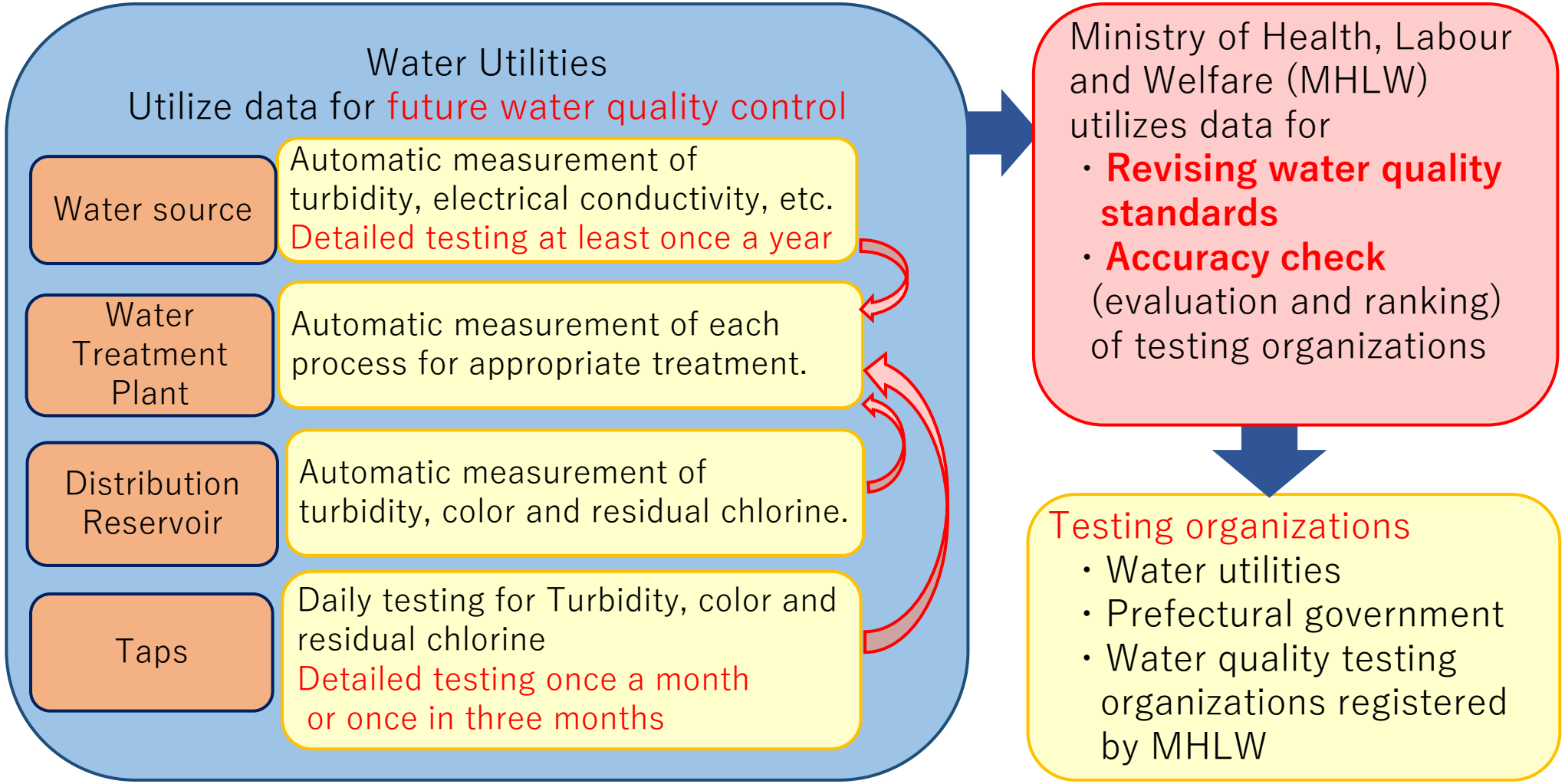
Customer‘s right to request water quality testing

Awareness of responsibility by water utilities to provide safe water.

Integrated water quality management by water utilities

2. Importance of Water Quality Management

(2) Water Quality Management System



2. Importance of Water Quality Management

(3) Cost of Water Quality Management

Water quality management requires…

Skilled staff to conduct water quality management activities

Water treatment chemicals

Energy for water treatment plant

Management and **operation** of appropriate organization

Water quality management costs

Estimation of cost in drafting business plan

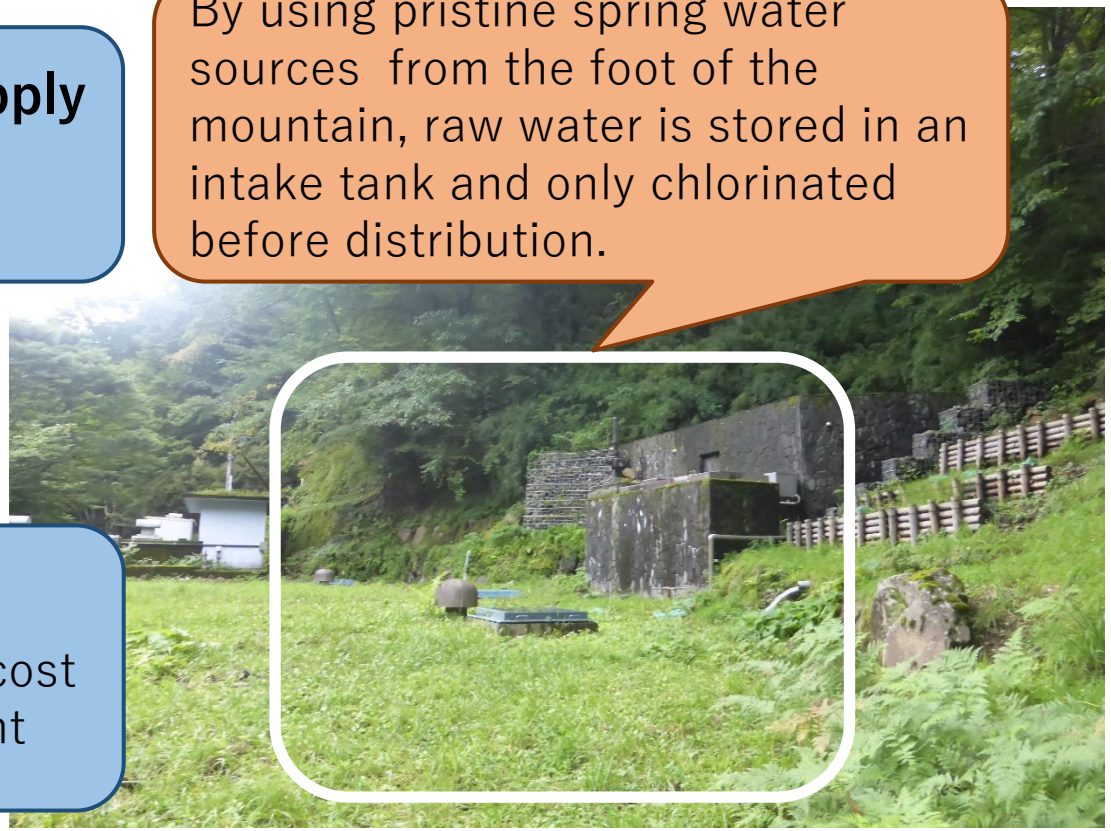
2. Importance of Water Quality Management

Small Scale Public Water Supply Using Good Quality Water Sources

Small Scale Public Water Supply
- Limited financial capacity
- Understaffing

Pristine water source
- Reduction of water treatment cost
- Easy water quality management

By using pristine spring water sources from the foot of the mountain, raw water is stored in an intake tank and only chlorinated before distribution.



2. Importance of Water Quality Management

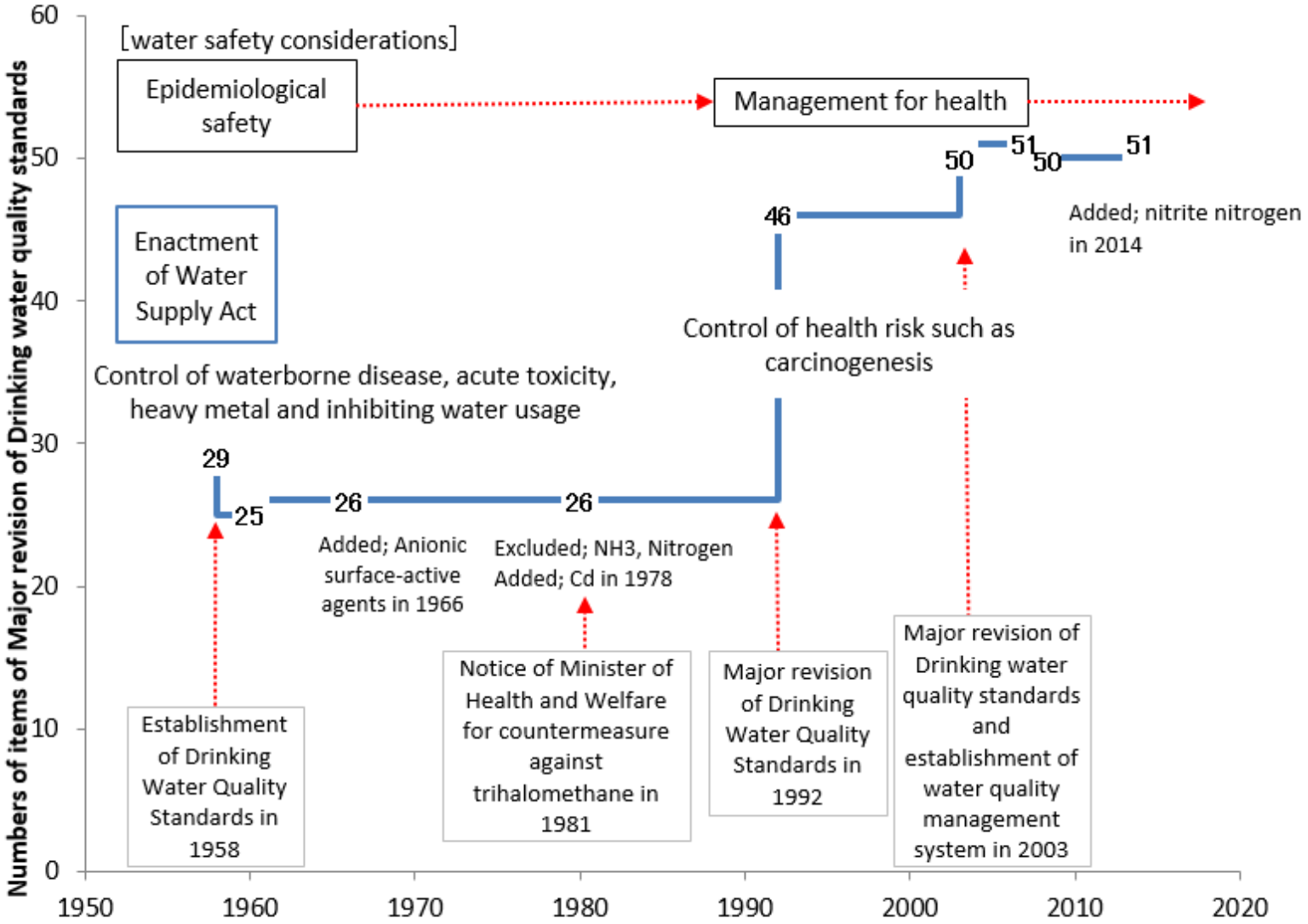
(4) Clear Responsibility for Water Quality Management

Appoint responsible person for water quality management	**Water Supply Services Technical Administrator (Article 19)** Responsibilities ● Inspection of water supply facilities to meet technical standards ● Water quality examination ● Sanitary measures such as disinfection ● Water supply suspension
Establish administrative checking system	**On-site inspection, guidance and supervision by a supervising authority (Article 36, Article 39 of the Water Supply Act)** On-site inspection, instruction for improvement and water supply suspension order by the national government or prefectural government
Assist small and medium scale water utilities whose capacity is limited	**Support by health center** ● Assessment of result of water quality examination ● Providing technical information

3. Drinking Water Quality Standards

(1) Formulation of Drinking Water Quality Standards

Drinking Water Quality Standards in Japan have been developed and modified based on the new knowledge on toxic substances and the technical level of water quality testing.



3. Drinking Water Quality Standards

(2) Notifications about Drinking Water Quality

National Government
(Water Supply Division of the Ministry of Health, Labour and Welfare)

Article 39 of the Water Supply Act; Collection of reports and on-site inspection
Article 36 of the Water Supply Act; Instruction for improvement, etc.
Article 14 of the Order for Enforcement of Water Supply Act; Delegation of authority to the prefectural governors

Prefectural government,
City with health centers

Health center | Health center | Health center | Health center

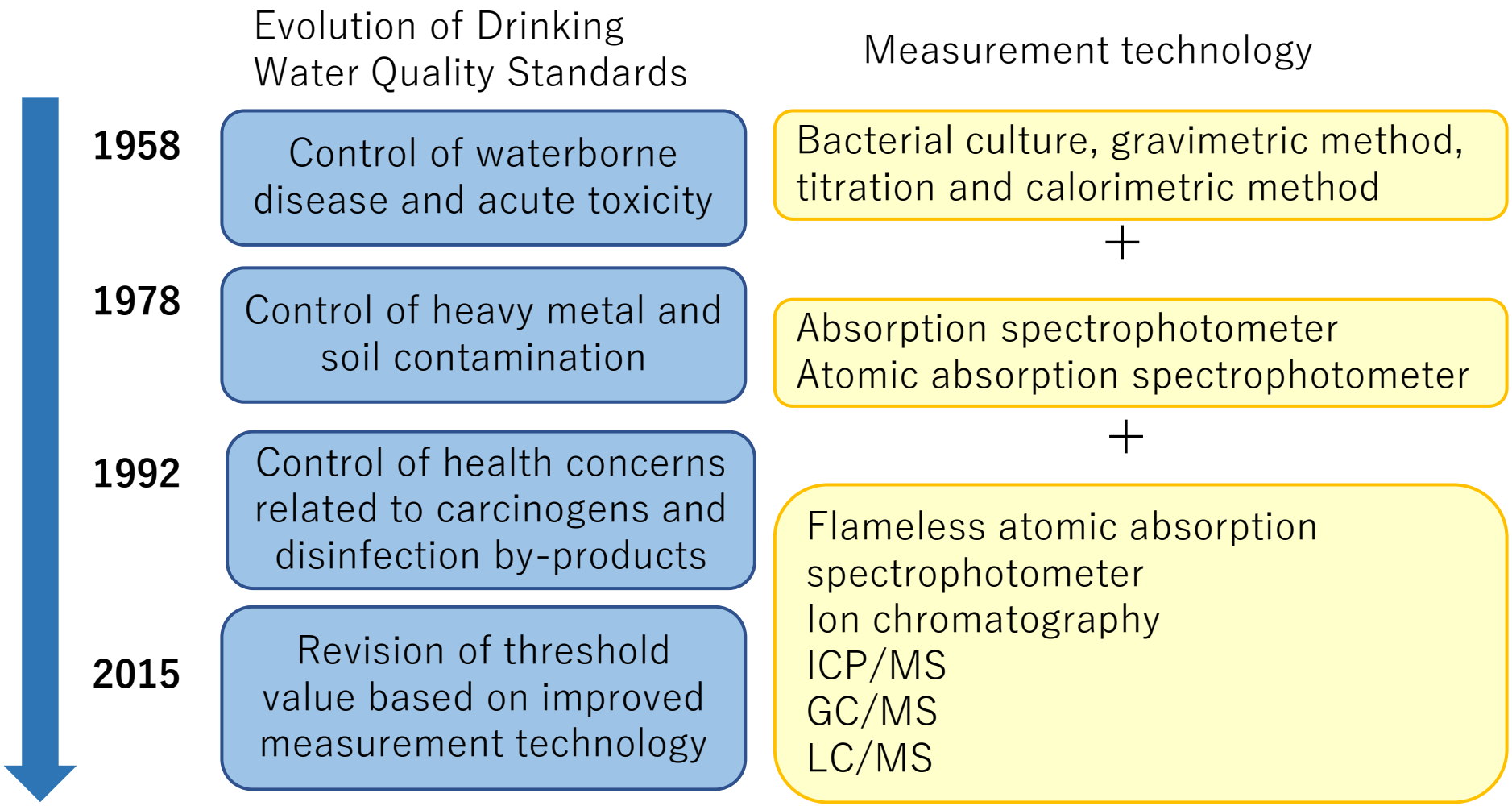
Water utilities
Planned service population ≦50,000

Water utilities
Planned service population ＞50,000

Health center; Organization established based upon Community Health Act
Ensures comprehensive promotion of regional public health measures

4. Drinking Water Quality Testing

(1) Water Quality Parameters and Testing Methods



4. Drinking Water Quality Testing

(2) Responsibility for Water Quality Testing

How can Small-Scale Utilities manage water quality testing?

Water utilities must make their own arrangements for water quality testing

1. Establish a shared testing facility
2. Utilize external service such as health centers, etc.

Water quality testing by health centers became difficult as parameters stipulated in Drinking Water Quality Standards increased.

Increasing outsourcing to private testing facility registered by the Minister of Health, Labour and Welfare

Water utilities prepare a water quality monitoring plan, conduct daily tests (residual chlorine, color and turbidity) by themselves, judge the safety of water and guarantee water quality.

4. Drinking Water Quality Testing

(3) Administrative Framework for Water Quality Testing

Contents of water quality monitoring plan

1. Specific water quality issues that require attention in the water quality monitoring plan
2. Items, sampling points and frequency for regular water quality testing
3. Items omitted from regular testing and the reasons
4. Items for extraordinary water quality testing and the reasons
5. Tests that will be outsourced, when water utilities send samples to health centers or private laboratories
6. Other issues to be considered, such as evaluation of the results, revision of the water quality monitoring plan, quality control, and reliability assessment

The national government or the prefectural government checks the water quality monitoring plan and recommends improvements where necessary.

4. Drinking Water Quality Testing

People engaged in Water Quality Management

Manufacturers of material and equipment for water supply

- Maintenance in usual operations
- Measures in an emergency

Water utilities

- Technical administrator
- Sanitary engineers, mechanics, electricians, etc.
- Technicians of the laboratory
- Staff who monitor water quality at tap

Administrative staff in government

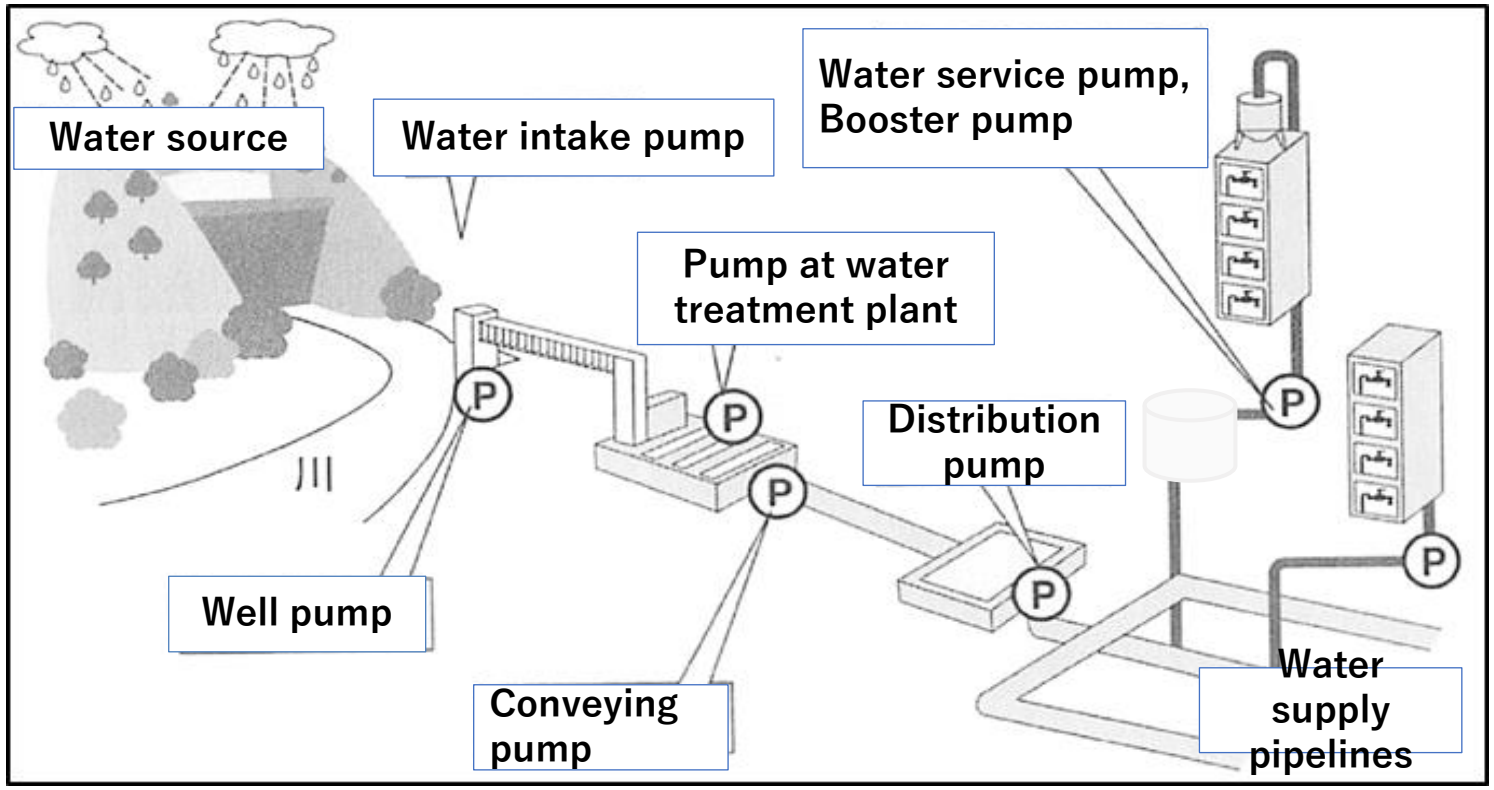
- Providing new information about water quality
- Check for compliance of water quality management

5. Standards for Materials and Equipment for Water Supply

Water quality management
from water source to each tap

→

Need to ensure quality of material and equipment for water supply



5. Standards for Materials and Equipment for Water Supply

Japan Water Works Association (JWWA) conducts inspection of material and equipment for water supply facilities

Japan Water Works Association, "*Profile Public Interest Incorporated Association Japan Water Works Association*," [Online] Available: http://www.jwwa.or.jp/jigyou/kaigai_file/JwwaProfile2015.pdf [Accessed 11 July 2016]

6. Preventing Deterioration of Source Water Quality

(1) Action taken in response to Changes in Source Water Quality

Year	Laws and systems	Issues of water quality management	Water supply coverage*
1954		Period of High Economic Growth	33%
1964	The River Act was enacted.		69%
1967		Water pollution by industrial wastewater,	72%
1970	The Water Pollution Control Act was enacted.		81%
1973		Contamination by household wastewater with the rise of water supply coverage	84%
1979		Trihalomethane problem Toxicity of water-bloom, odor of purified water	91%
1988	National subsidy for advanced water treatment started.		94%
1994	The Law concerning the Promotion of Projects	Countermeasure against disinfection by-products is required.	95%
2001	The Johkasou(decentralized treatment system) Law was amended.	Dissemination of combined Johkasou(decentralized treatment system)	97%
2014	The Basic Act on the Water Cycle was enacted.		98%

*Water supply coverage is according to estimation until 1955 and "Water Supply Statistics" since 1956.

6. Preventing Deterioration of Source Water Quality

(2) Conservation of Water Catchment Forests

Under the Forest Act water utilities have made efforts to conserve the forests in the catchment area, to improve source water quality and quantity.

In order to protect water sources proactively, water utilities

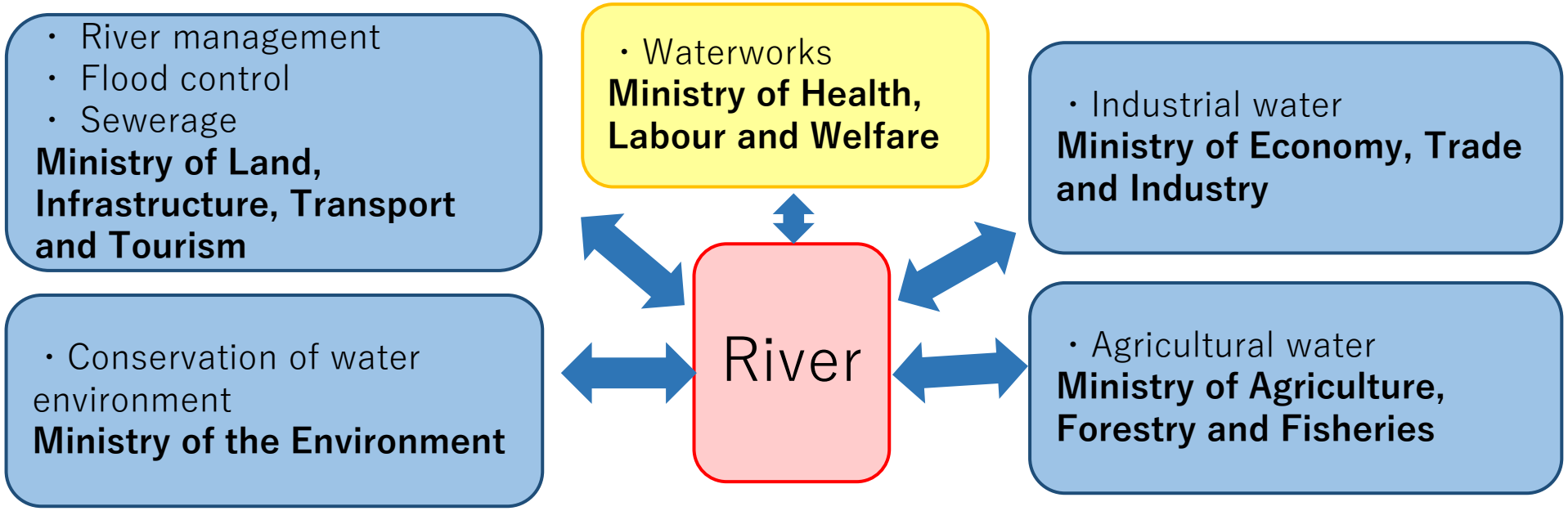
- Procure forests in the upstream area
- Call for volunteers to take care of trees

Example of Catchment Forest Conservation by Some Utilities

Water utility	Location	Area
Tokyo Metropolis	Upstream of Tama River (Okutama machi and part of Yamanashi Prefecture), started in 1910 as the first attempt	23,000ha
Yokohama City (Kanagawa pref.)	Upstream of Doshi River (Yamanashi Prefecture), located outside Kanagawa pref.	2,873ha
Kagawa Prefecture	Upstream of Yoshino River (Kochi Prefecture) Subsidy for improvement cutting and tree thinning for water source forest.	–

6. Source Water Quality

(4) Practical countermeasures against water source pollution



Two Laws concerning drinking water resources (enacted in 1994)

Ministry of Health, Labour and Welfare	Act on Advancement of Project for Quality Management of Raw Water
Ministry of the Environment	Act on Special Measures concerning Water Quality Conservation at Water Resources Area in Order to Prevent the Specified Difficulties in Water Utilization

6. Source Water Quality

Background of the Basic Act on Water Cycle

Bottom-up movement for legislation from scholars, citizens, and politicians

・Scholars ・Citizens
・ Diet members

- Fragmented regulation on water
- Insufficient legal framework to control groundwater
- Necessity for sound basin-wide water management

legislation by Diet members

Enactment of the bill in 2014

- Leadership by prime minister to coordinate line ministries
- Decision of “Water Cycle Basic Plan” each five years

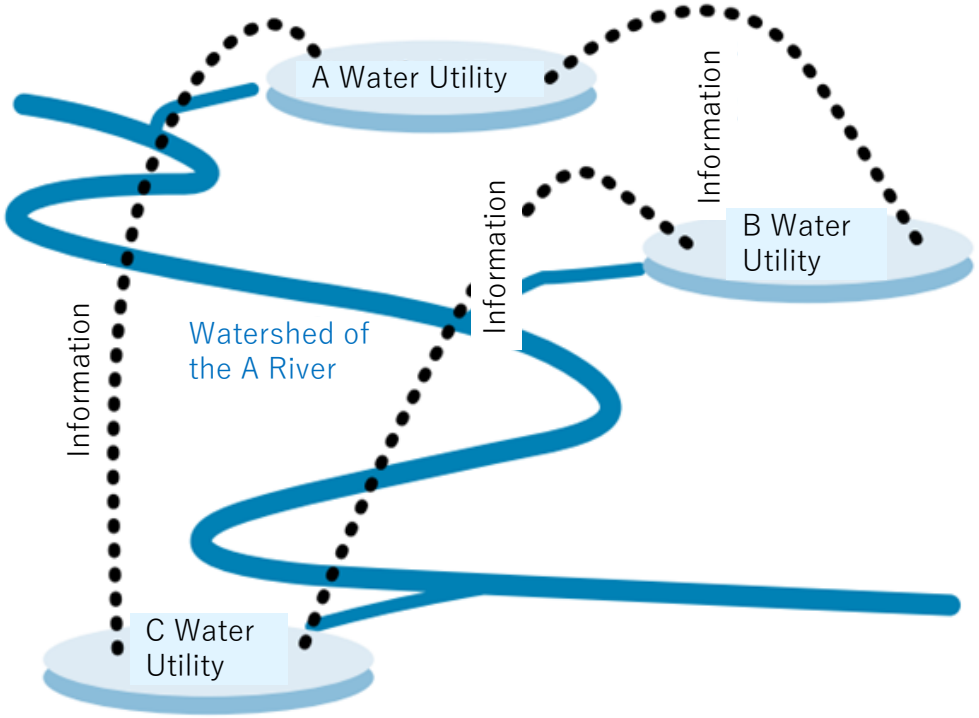
6. Source Water Quality

Necessity of cooperation between upstream and downstream users

Councils of stakeholders for information sharing and dialogue, assembled in each watershed

Cooperation between environmental administration and water supply administration in Prefecture

Water Safety Plan based on information of watershed

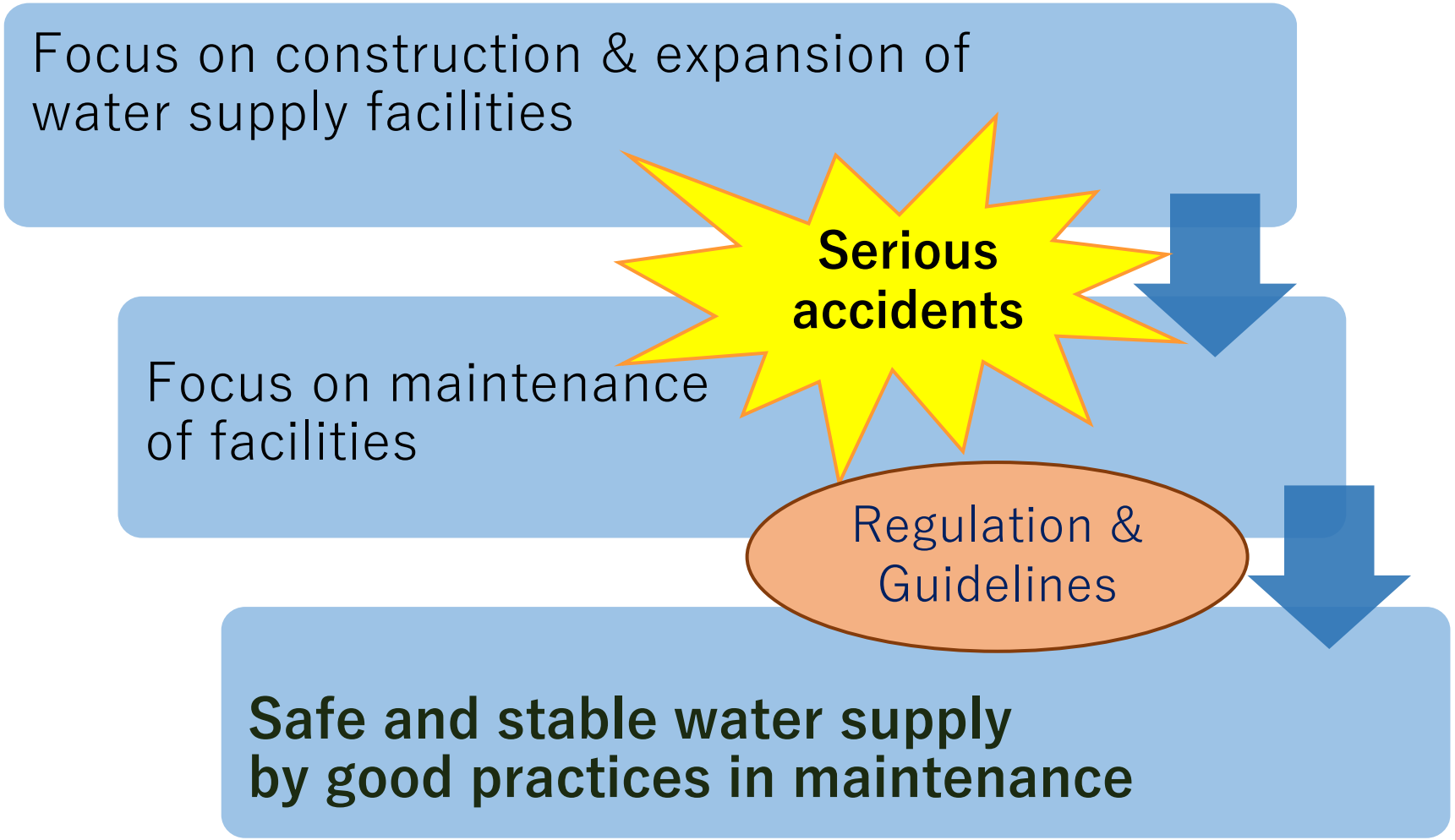


Operation and Maintenance of Facilities

Source: JICA Training Course Material prepared by Sapporo City Waterworks Bureau（JICA Sapporo, 2015）

No. T4 Ver. 1

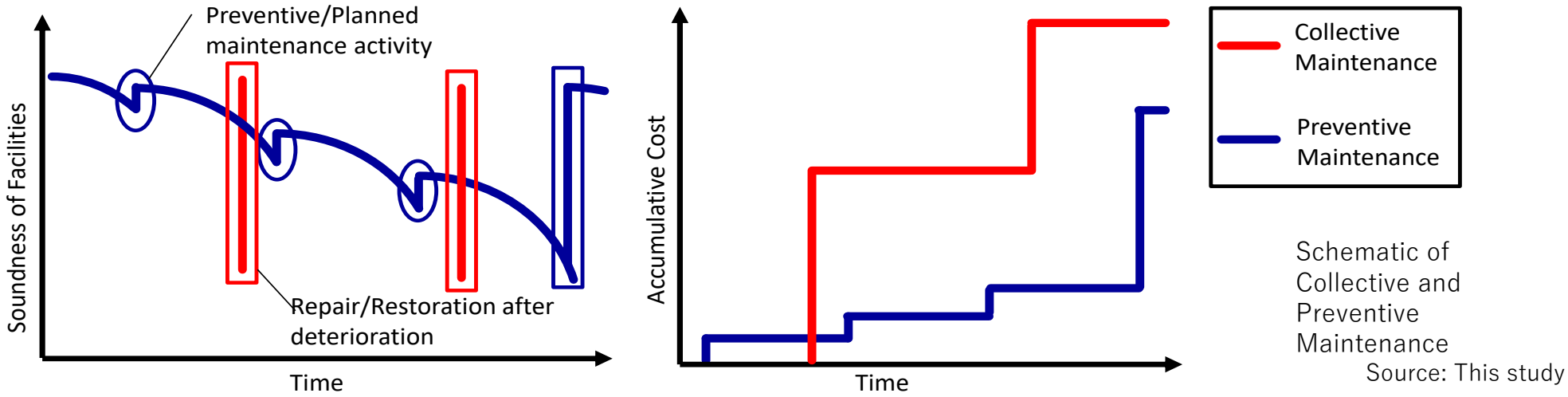
1. Introduction



2. Importance of Maintenance

Why maintenance is important?

- Inadequate maintenance can cause operation fault and service deterioration
- Secondary disaster (e.g. road collapse by pipe burst, chlorine leakage)
- Service breakdown: poor water quality, reduced pressure, perception of reduced reliability, claims from customers.
- Higher life cycle cost: early deterioration of facilities



Schematic of Collective and Preventive Maintenance

Source: This study

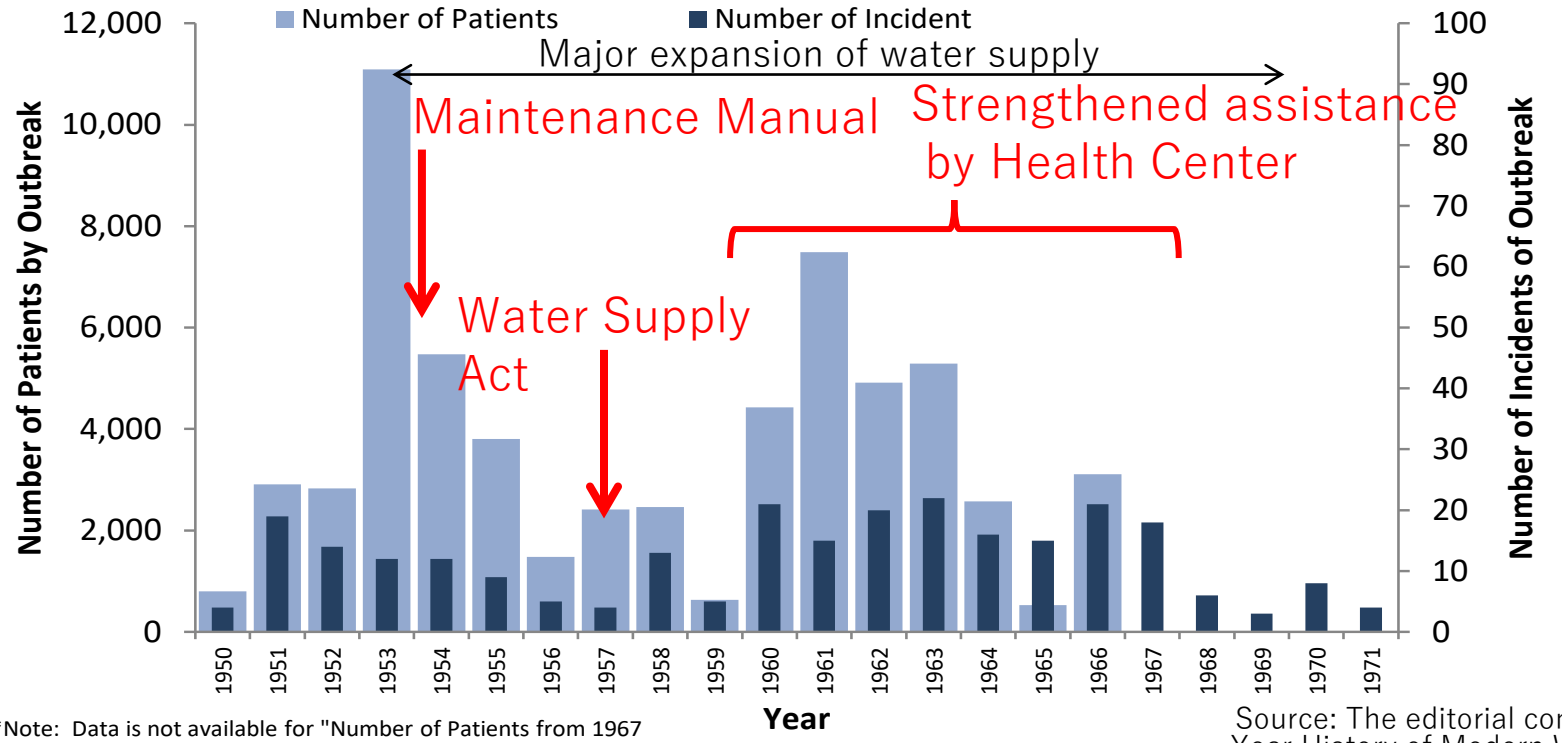
2. Importance of Maintenance

Item	Triggering events	Issues and causes
Water Treatment Facility	Poor disinfection (waterborne diseases spread by water supply)	No standard manuals nor operational procedures for O&M
	Malfunction of facility and failure of water treatment	
Pipelines	Contamination due to negative pressure (waterborne diseases spread by water supply)	No precise information nor drawings on aged pipelines
	Secondary disaster due to burst pipes	
	Public complaint of rusty/turbid water	
	Dysentery caused by cross connection	Quality control for installation of water service connections

2. Importance of Maintenance

(1) Disease Outbreaks

- Outbreaks increased when water supply coverage was expanded to rural areas where many small utilities were built (since the 1950s).
- Cases were dramatically decreased by intensive O&M measures promoted by *Water Supply Facilities Maintenance Manual* in 1953.



*Note: Data is not available for "Number of Patients from 1967

Source: The editorial committee of the One Hundred Year History of Modern Water Supply, "*One Hundred Year History of Modern Water Supply*," Nihon Suido Shimbunsha, 1988.

2. Importance of Maintenance

Causes of Outbreaks of Waterborne Diseases

42%: Lack or failure of disinfection facilities

27%: Contamination in pipelines *

1950s~1960s: Focus on Operation and Maintenance

- Laws and Regulations
- Guidelines
- Best practices and dissemination throughout the country

1970s: Outbreaks of waterborne diseases caused by water supply system were suppressed.

* caused by water supply interruption, cross contamination etc.

2. Importance of Maintenance

(2) Cross Connection

Serious Accident of Cross Connection in1969
It was found that a water distribution pipe had been connected to an industrial water pipe by mistake of pipe installation work. People had been drunk industrial water for one year.

Causes
- Drawings and documentation not properly archived
- No appropriate construction supervision
- No water quality testing after construction

Corrective measures
- Strengthening of construction supervision
- Records of construction
- Registration of drawings
- Strengthening of completion inspection
- Testing for residual chlorine

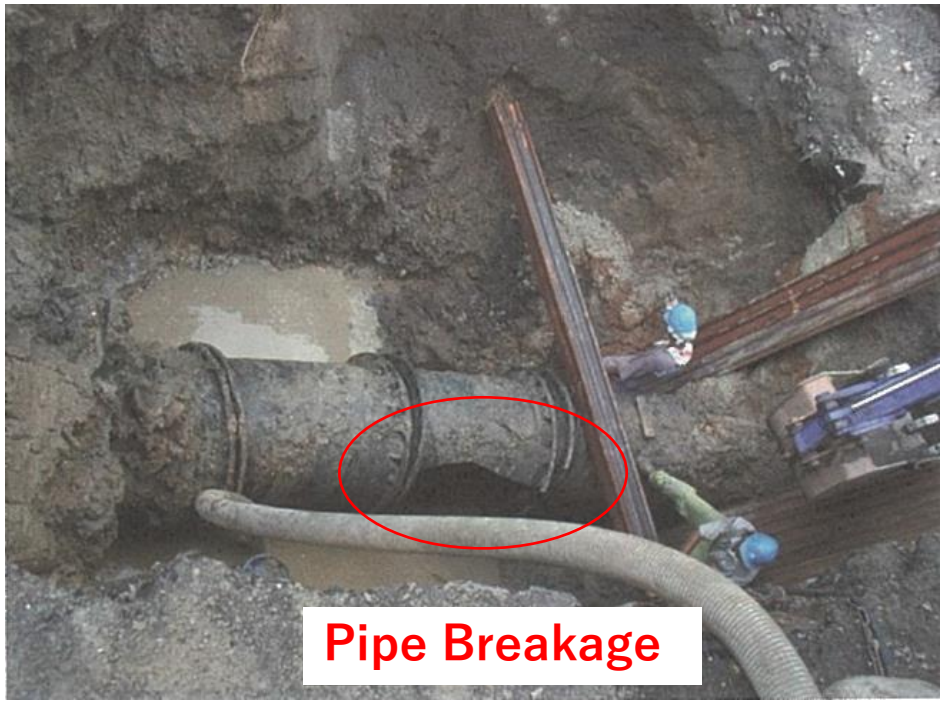
Great impact on both the citizens and utilities

2. Importance of Maintenance

(3) Pipe Bursts

Pipe materials deteriorate with age

Causes	●Corrosion ●Deterioration of materials ●Old lining method
↓	
Effect	●Water supply interruption ●Road caving ●Flooding of homes and roads
↓	
Measures	●Accelerate scheduled replacement of aging pipes ●Emergency management



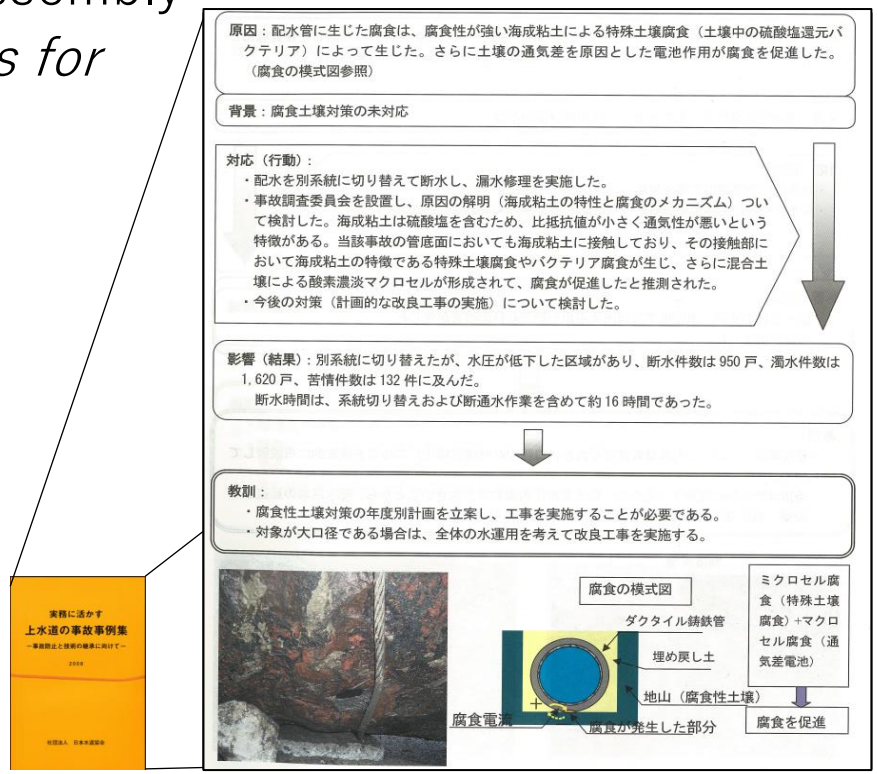
Source: JWWA, "*Casebook of Water Supply Accidents for Practical Use*," 2008.
Note: Photo is modified from original (indicated in red)

2. Importance of Maintenance

Information sharing among utilities across Japan

- Annual academic conference held in Japan Water Works Association General Assembly
- *Casebook of Water Supply Accidents for Practical Use*

Japan Water Works Association General Assembly Meeting



JWWA, "*Casebook of Water Supply Accidents for Practical Use*," 2008.

2. Importance of Maintenance

Improved Management of Pipelines

Laws and regulations were enforced in response to the accident.

Year	Events Related Leakage Control in Japan
1945	**End of World War II** (pipeline damage by war)
1946	***Water Leakage Prevention Guidelines*** (Ministry of Health and Welfare, Japan Water Works Association)
1950s	**Aged pipelines installed before the war and deterioration of pipes of poor material manufactured during the war.**
1960	***Revision of the Water Leakage Prevention Guideline*** (Bureau of Waterworks, Tokyo Metropolitan Government water leakage prevention committee)
1960	Notice of the Ministry of Health and Welfare: **on water leakage prevention measures**
Around 1970	Media reports on rusty water causing public concern.
1970	Notice of the Ministry of Health and Welfare: **on pipeline repair and replacement to prevent leakage and removal of rusting pipes**
1977	***Guidelines for Water Leakage Preventive Measures***

3. Laws and Institutional Framework

Legal Basis on Maintenance

- The Water Supply Act clearly stipulates the importance of abiding by the maintenance and facility standards.
- Japan Water Works Association published *Design Criteria for Water Supply Facilities* and *Water Supply Facilities Maintenance Manual*.

Water Supply Act

"Article 5, 2 … In determining the location and arrangements of water supply facilities, it is necessary to make their construction, ***operation and maintenance*** *as economically and easily as possible, and to give consideration to assurance of water supply…*

Based on the Act, technical standards are developed & regularly updated.

Technical standards

3. Laws and Institutional Framework

Chronology of Laws and Regulations

1953: *Water Supply Facilities Maintenance Manual*

1955: *Water Supply Facilities Standards*

1957: Water Supply Act was enacted

1964: Revision
1970: Revision
1982: Revision
1998: Revision
2006: Revision

1966: *The Design Criteria for Water Supply Facilities*

1977: Revision
1990: Revision
2012: Revision

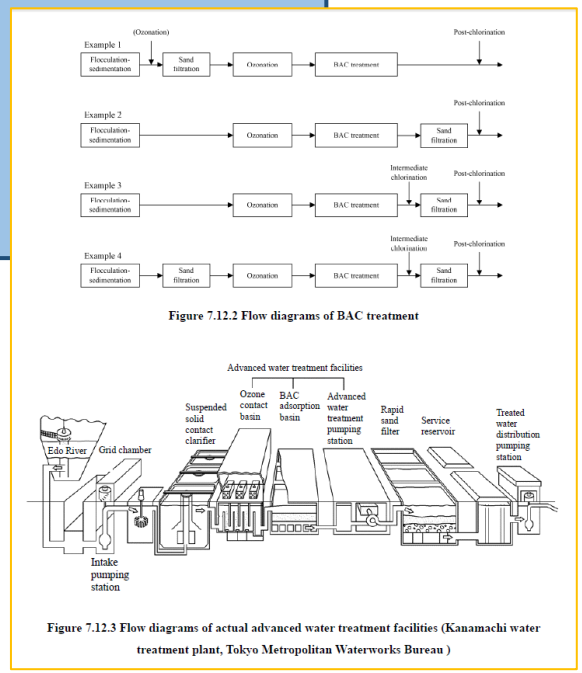
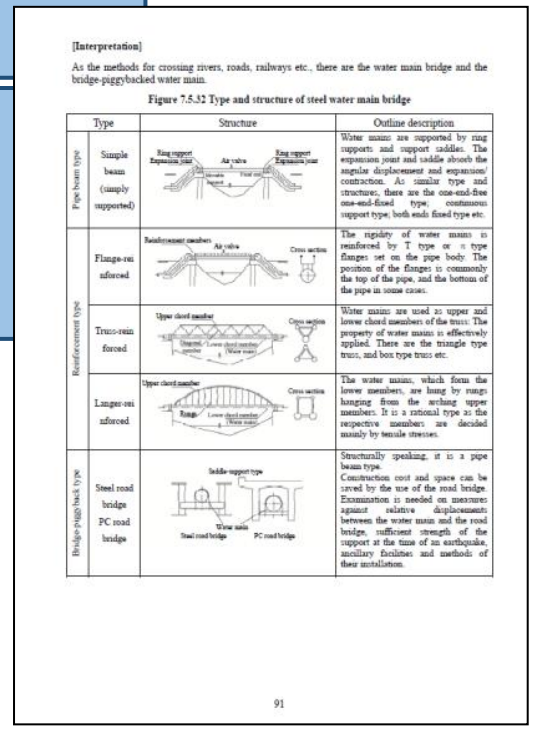


Figure 7.12.2 Flow diagrams of BAC treatment

Figure 7.12.3 Flow diagrams of actual advanced water treatment facilities (Kanamachi water treatment plant, Tokyo Metropolitan Waterworks Bureau)



[Interpretation]

As the methods for crossing rivers, roads, railways etc., there are the water main bridge and the bridge-piggybacked water main.

Figure 7.5.32 Type and structure of steel water main bridge

Type		Structure	Outline description
Pipe beam type	Simple beam (simply supported)		Water mains are supported by ring supports and support saddles. The expansion joint and saddle absorb the angular displacement and expansion/contraction. As similar type and structures, there are the one-end-free one-end-fixed type, continuous support type, both ends fixed type etc.
Reinforcement type	Flange-reinforced		The rigidity of water mains is reinforced by T type or π type flanges set on the pipe body. The position of the flanges is commonly the top of the pipe, and the bottom of the pipe in some cases.
	Truss-reinforced		Water mains are used as upper and lower chord members of the truss. The property of water mains is effectively applied. There are the triangle type truss, and box type truss etc.
	Langer-reinforced		The water mains, which form the lower members, are hung by rungs hanging from the arching upper members. It is a rational type as the respective members are decided mainly by tensile stresses.
Bridge-piggyback type	Steel road bridge PC road bridge		Structurally speaking, it is a pipe beam type. Construction cost and space can be saved by the use of the road bridge. Examination is needed on measures against relative displacement between the water main and the road bridge, sufficient strength of the support at the time of an earthquake, ancillary facilities and methods of their installation.

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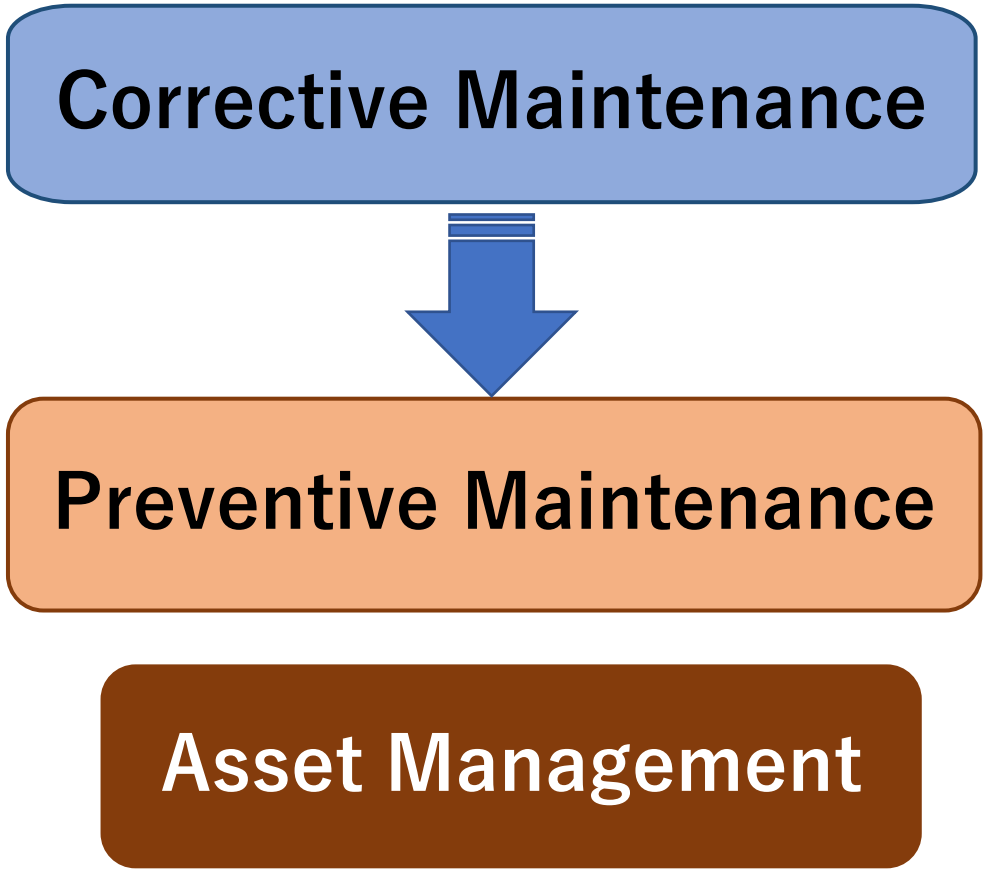
4. Best Practices in Japan

(1) Corrective and Preventive Maintenance

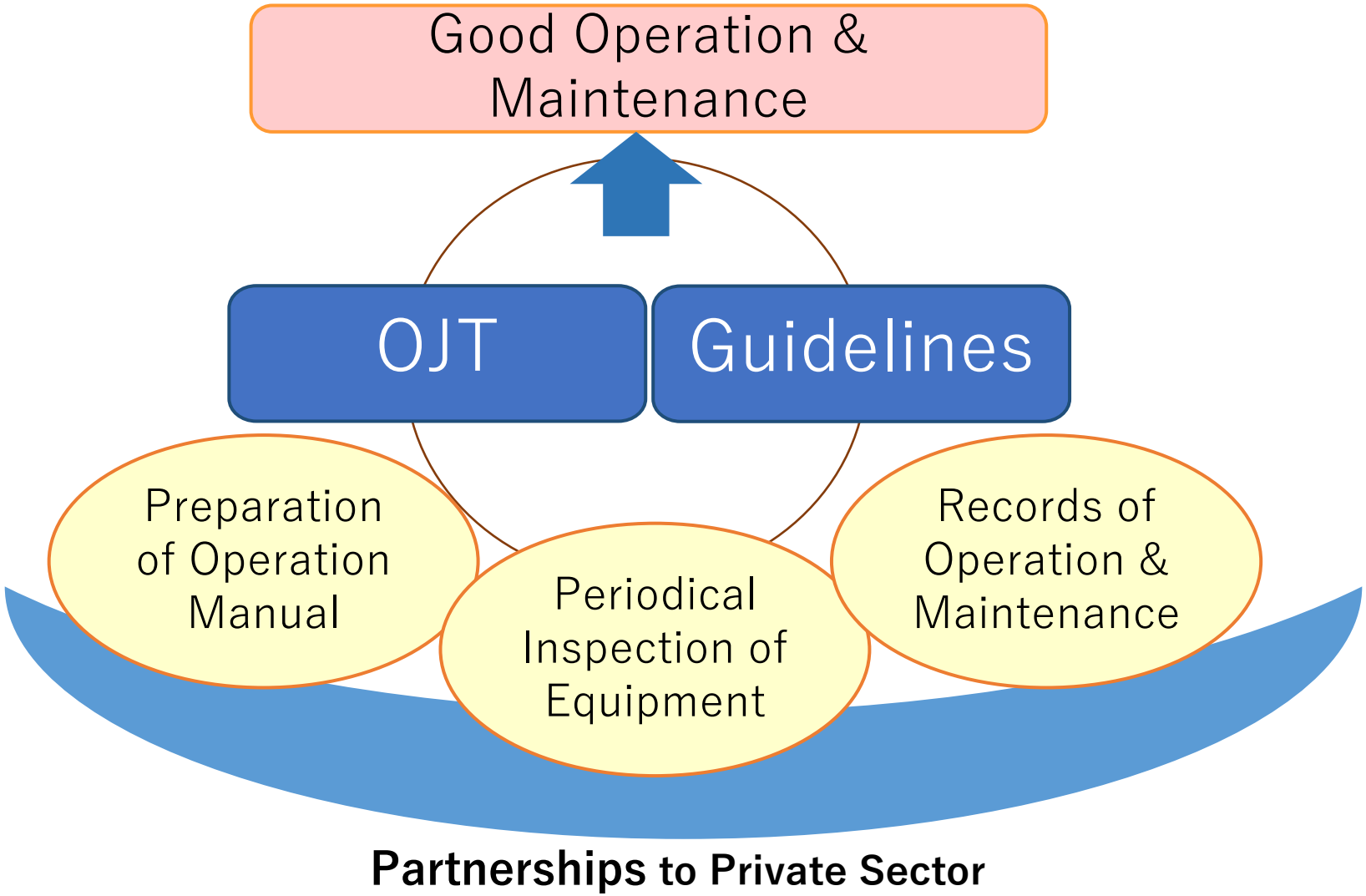


Repaired or replaced when the problem was discovered

Planned renewal of facilities

4. Best Practices in Japan

(2) Maintenance in Water Treatment Plants



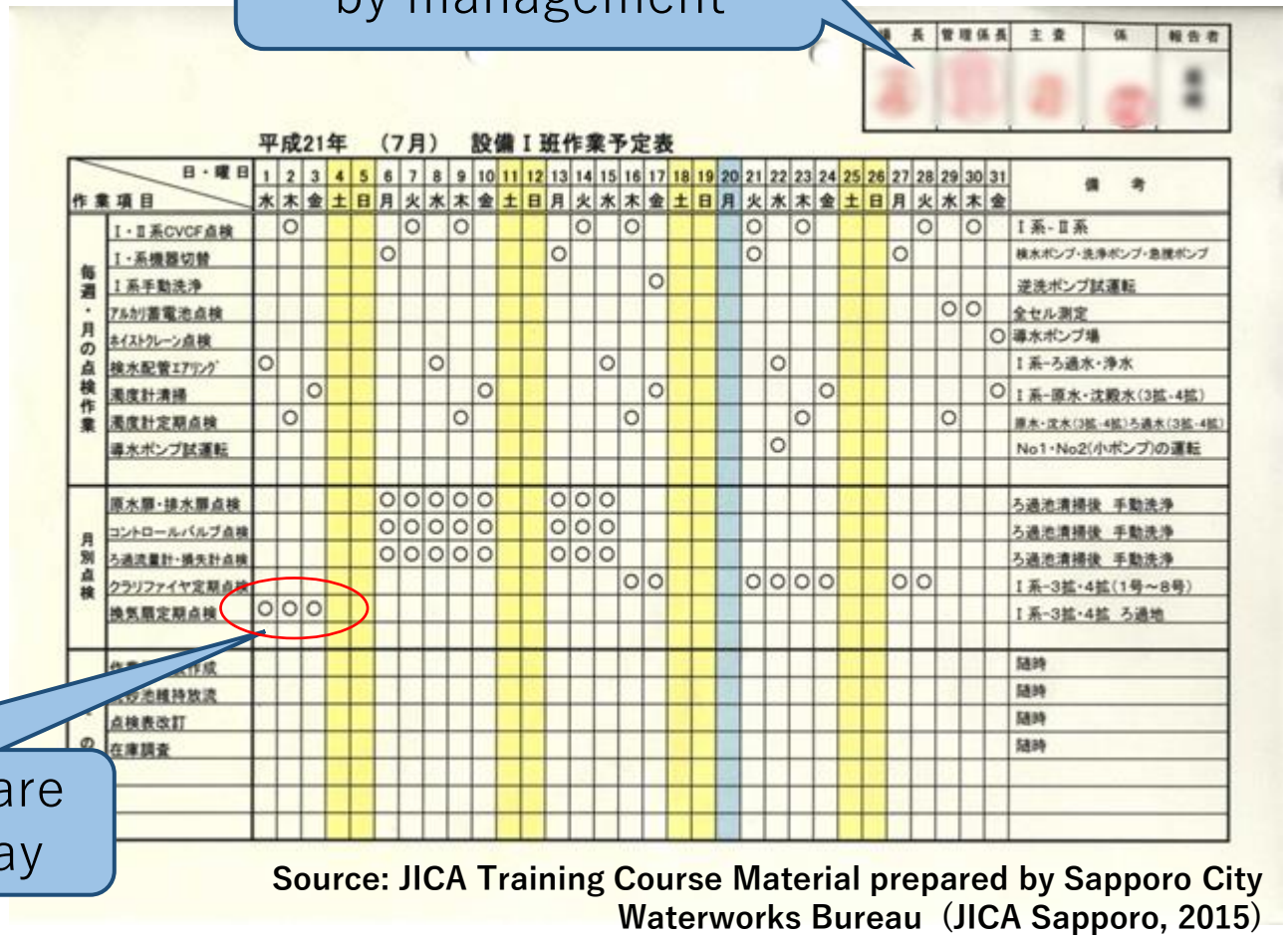
4. Best Practices in Japan

Example of Checklist

Check list of periodical inspection (Sapporo City)

Shared and approved by management

Items to be checked are identified for each day



平成21年　（7月）　設備Ⅰ班作業予定表

作業項目	日・曜日	1 水	2 木	3 金	4 土	5 日	6 月	7 火	8 水	9 木	10 金	11 土	12 日	13 月	14 火	15 水	16 木	17 金	18 土	19 日	20 月	21 火	22 水	23 木	24 金	25 土	26 日	27 月	28 火	29 水	30 木	31 金	備考
毎週・月の点検作業	Ⅰ・Ⅱ系CVCF点検		○					○		○					○		○					○		○				○		○		Ⅰ系-Ⅱ系
	Ⅰ・Ⅱ系機器切替						○							○								○						○				検水ポンプ・洗浄ポンプ・急速ポンプ
	Ⅰ系手動洗浄																	○														逆洗ポンプ試運転
	アルカリ蓄電池点検																												○	○			全セル測定
	ホイストクレーン点検																															○	導水ポンプ場
	検水配管エアリング	○							○							○							○									Ⅰ系-ろ過水・浄水
	濁度計清掃			○							○							○							○							○	Ⅰ系-原水・沈殿水(3拡・4拡)
	濁度計定期点検		○							○							○						○						○			原水・沈水(3拡・4拡)ろ過水(3拡・4拡)
	導水ポンプ試運転																					○										No1・No2(小ポンプ)の運転
月別点検	原水扉・排水扉点検						○	○	○	○	○			○	○	○																	ろ過池清掃後　手動洗浄
	コントロールバルブ点検						○	○	○	○	○			○	○	○																	ろ過池清掃後　手動洗浄
	ろ過流量計・損失計点検						○	○	○	○	○			○	○	○																	ろ過池清掃後　手動洗浄
	クラリファイヤ定期点検																○	○				○	○	○	○			○	○				Ⅰ系-3拡・4拡(1号～8号)
	換気扇定期点検	○	○	○																													Ⅰ系-3拡・4拡　ろ過地
の	[illegible]作成																																随時
	[illegible]砂池維持放流																																随時
	点検表改訂																																随時
	在庫調査																																随時

Source: JICA Training Course Material prepared by Sapporo City Waterworks Bureau（JICA Sapporo, 2015）

4. Best Practices in Japan

(3) Pipeline Maintenance

Materials for distribution pipelines change as new materials and technologies become available .

Type	Diameter	Year 1960	1965	1977	1983
Main Distribution Pipe	>Φ1000	Cast Iron Pipes (Aged Pipes) →	DIP (No Lining) →	DIP (with Lining) →	DIP (with Lining, with Polyethilene Sleeve)
	>Φ400				
Distribution Pipes	>Φ250				
	>Φ75				

Cast Iron Pipe (Lead Coaking)


DIP (Polyethilene Sleeve)

4. Best Practices in Japan

(4) Construction Quality Management

Standardization and Replacement of Lead Pipes

- Lead pipes were historically widely used but are now intensively replaced because of negative health effect and leakage problems.
- Intensive replacement and standardization will prevent future problems.

Year	Change in standards for lead pipes
1928	Standards were set for lead pipes for water supply in Japan.
1990	Lining of lead pipes with zero elution were added to the standards.
1993	Based on the revision of the Water Quality Standards, the traditional unlined lead pipes were removed from the standards.

4. Best Practices in Japan

Asset Management

Leakage management and pipe replacement are dealt with cohesively under "Asset Management."

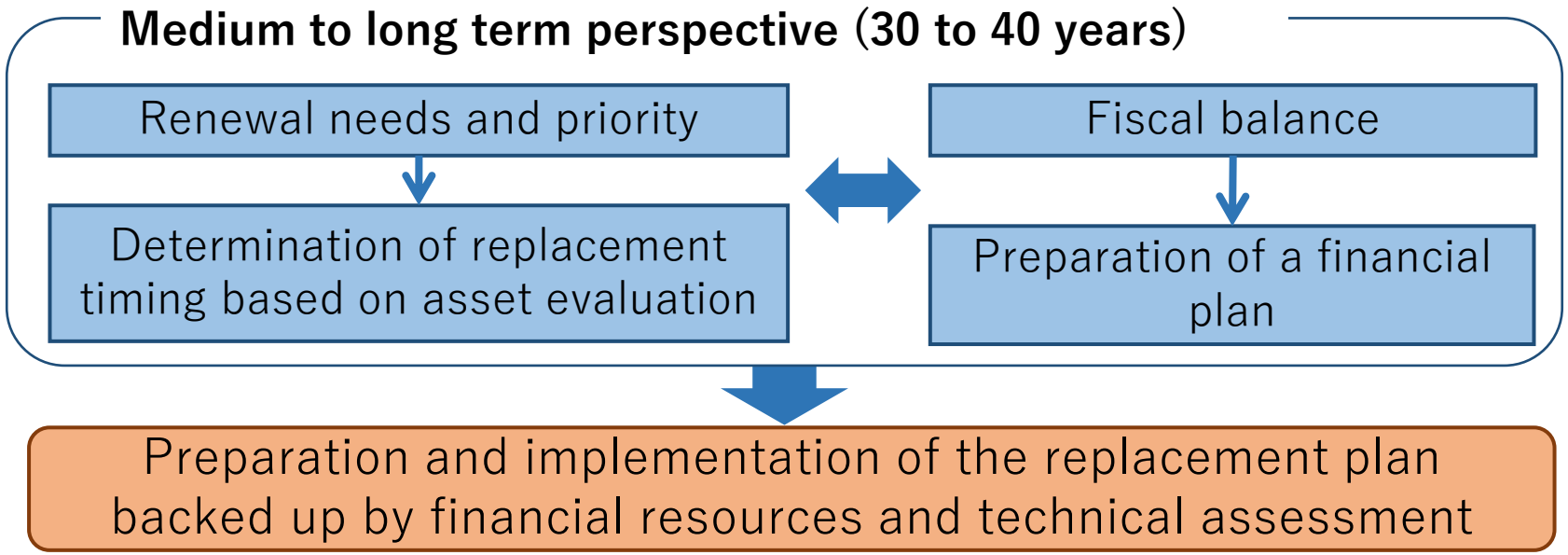
Key features of asset management:

(1) Consolidated information on facilities

(2) Facility assessment and evaluation

(3) Understanding of replacement needs and priorities

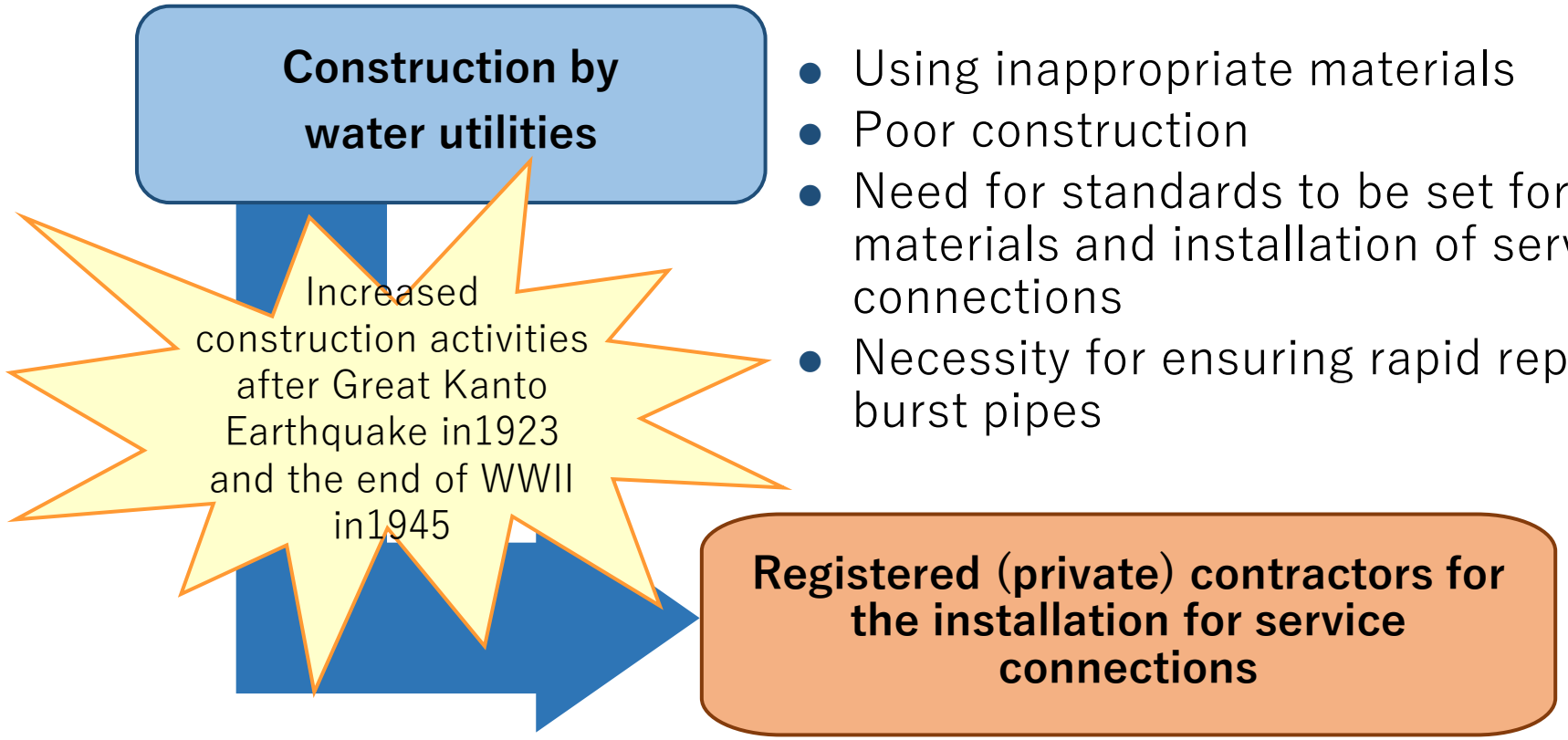
(4) Clear outlook on fiscal balance



Source: MHLW, *Guidelines for the Asset Management for Waterworks*, http://www.mhlw.go.jp/za/0826/d11/d11-01.pdf

4. Best Practices in Japan

Designated Prequalified Contractors and the Registration System for the Contractors for Service Connection



- Using inappropriate materials
- Poor construction
- Need for standards to be set for materials and installation of service connections
- Necessity for ensuring rapid repair of burst pipes

Financial Management:
Finance and Tariffs

No. T6 Ver. 1

Municipal Bond issued by Kyoto City in 1909
Source: Kyoto City Waterworks Bureau

2. Financing Water Supply Development

(3) Subsidies for Small Scale Public Water Supply

The Water Supply Division of the Ministry of Health and Welfare (MHW) persuaded the Finance Division of MHW to establish the subsidy by stating that **"the costs of improving water supply would be offset by economic benefits such as a reduction in health care costs."**

Subsidies for Small Scale Public Water Supply System in rural areas started in 1952.

180 Small Scale Public Water Supply System were developed in1952. After that, 500 Small Scale Public Water Supply System were developed every year.

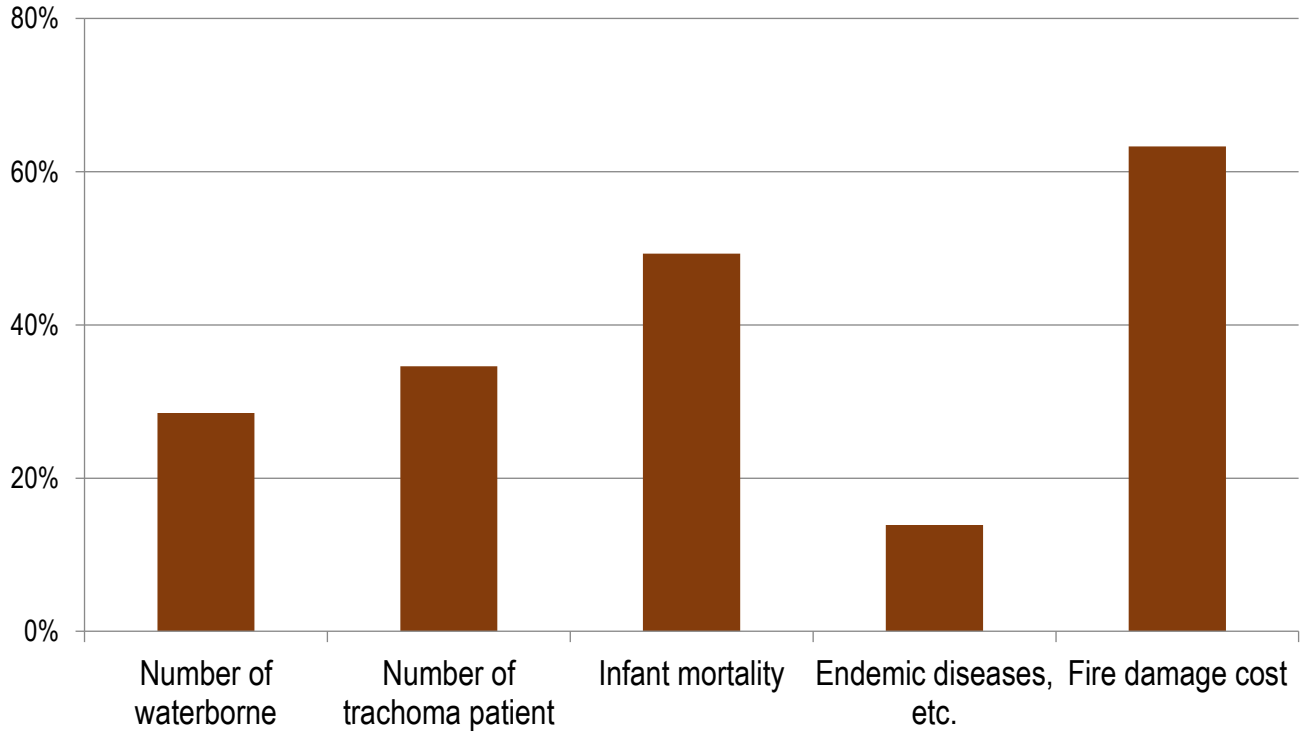
2. Financing Water Supply Development

Benefit of Rural Water Supply Development

Benefit of installing water supply facilities after 5 years of operation:

- **Decrease of waterborne diseases**
- **Decrease of infant mortality rate**
- **Decrease of damages from fires**

etc.



Source: The editorial committee of the One Hundred Year History of Modern Water Supply, "*One Hundred Year History of Modern Water Supply*," Nihon Suido Shimbunsha, 1988.

Reduced Incidence of Diseases and Infant Mortality, etc.
(Information presented by the Water Supply Division of MHW in 1957. 100% represents the level that existed before construction.)

2. Financing Water Supply Development

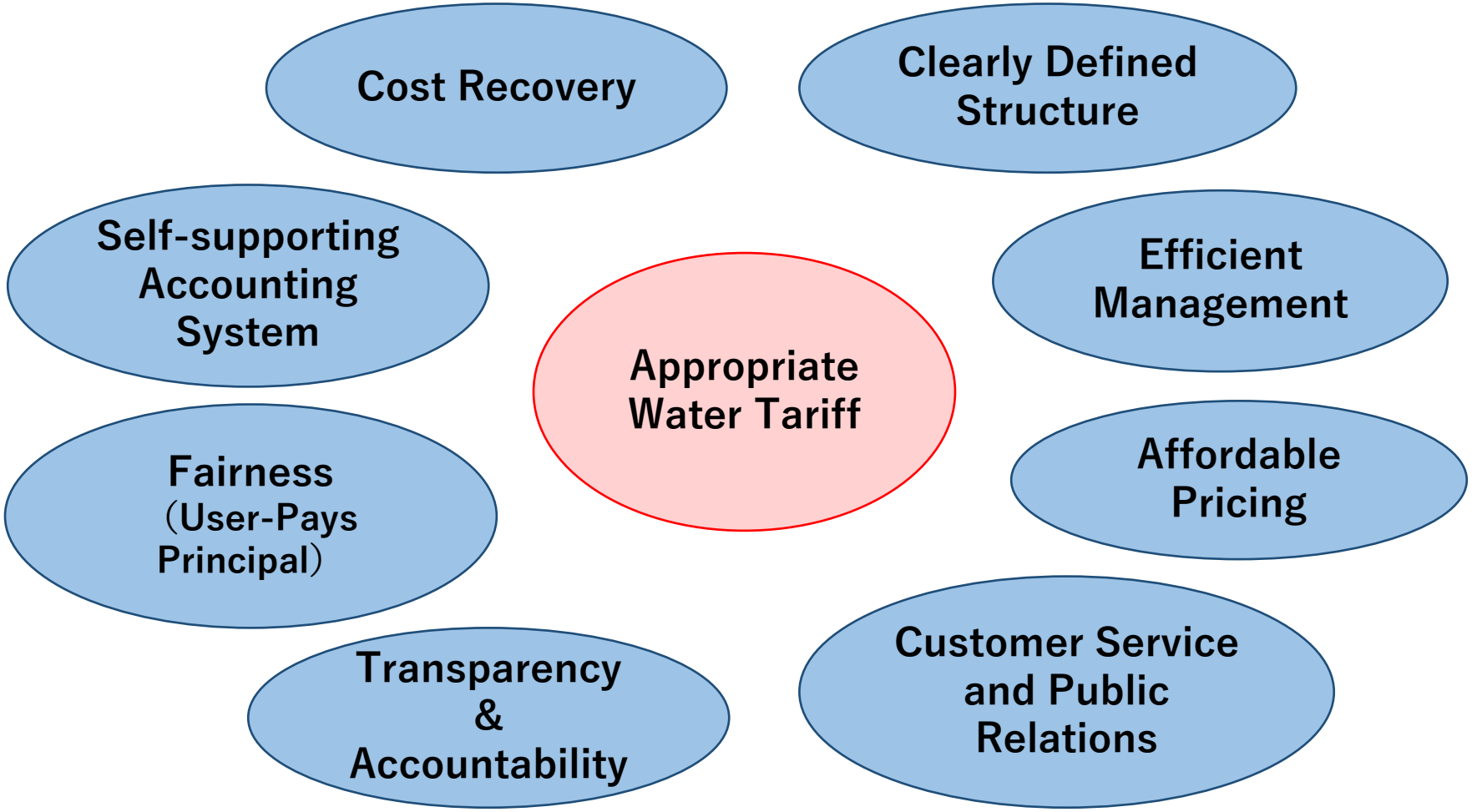
Villagers paid their share of the costs by selling their trees

Volunteer work by villagers for Small Scale Public Water Supply Development

Source: Susumu Hani, the film "*Water in Our Life*," 1952

3. Water Tariff Setting

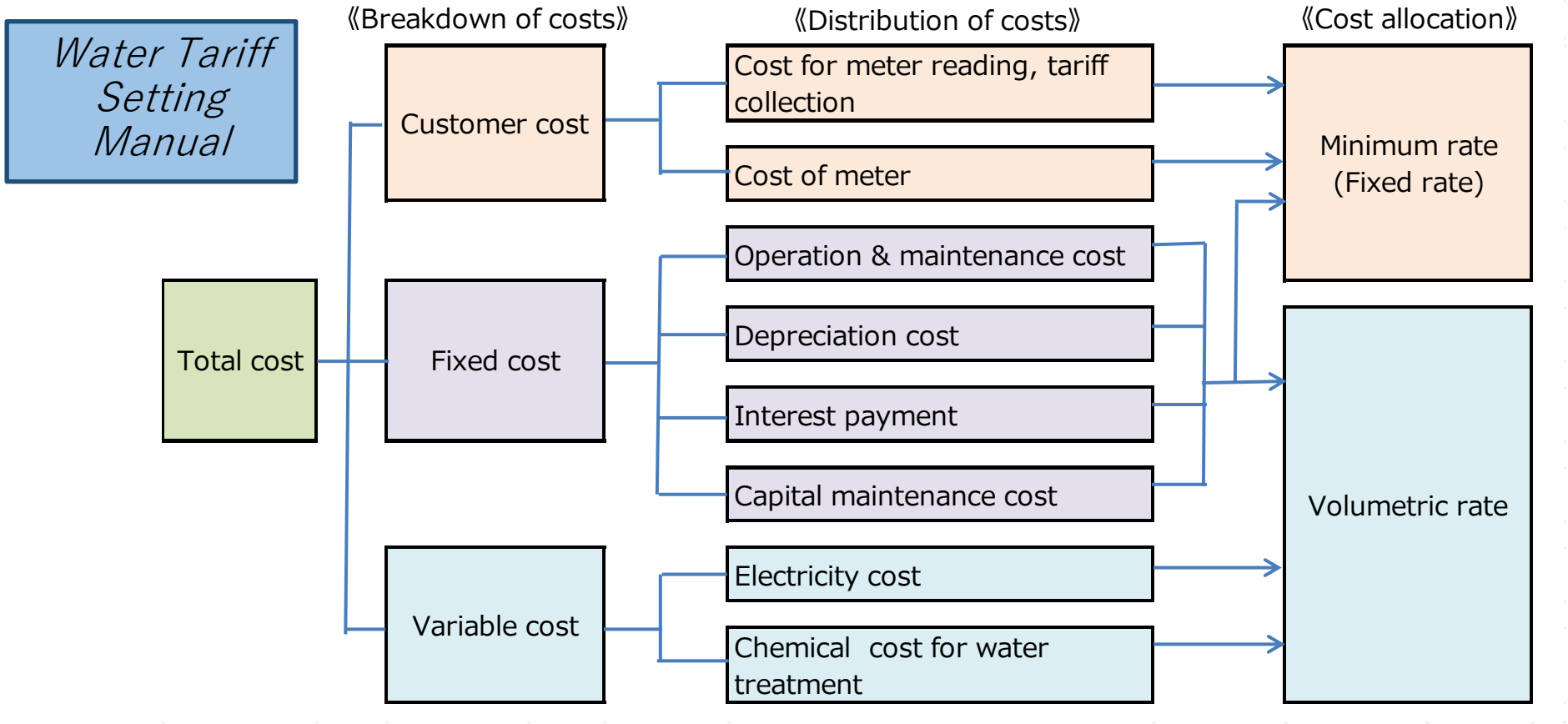
Main Components for Water Tariff Setting in Japan



3. Water Tariff Setting

(2) *Water Tariff Setting Manual*

Total Expenditure < **Total Revenue of Water Tariff**



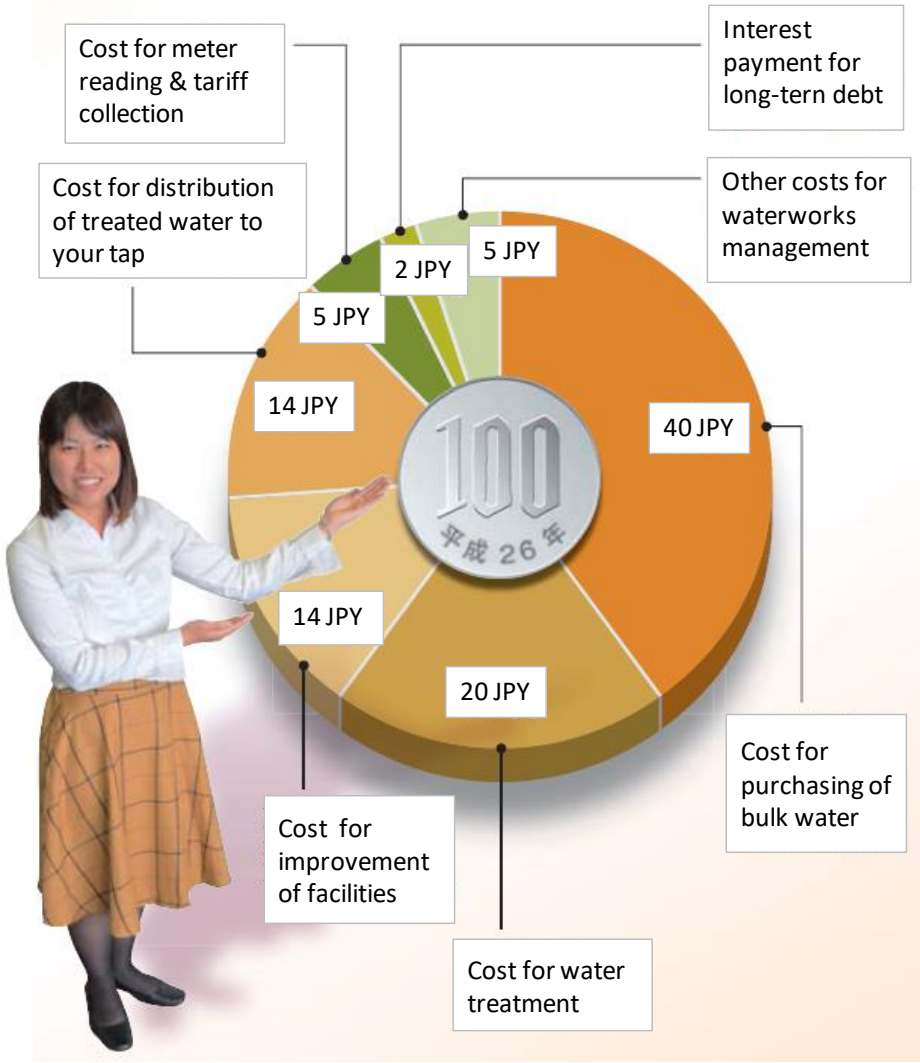
3. Water Tariff Setting

(4) Transparency & Accountability, Public Relations

Water Utility
Disclosure of financial information

Customer
Understanding of financial condition

How your 100 JPY is spent as water tariff?



Source: Kawanishi Water and Sewer Bureau, *Water Supply and Sewerage in Kawanishi: Secure for Drinking, Comfortable for Using*, 2015, http://www.kawanishi-water.jp/ikkrwebBrowse/material/files/group/2/h27-12-1.pdf

Institutional Management:

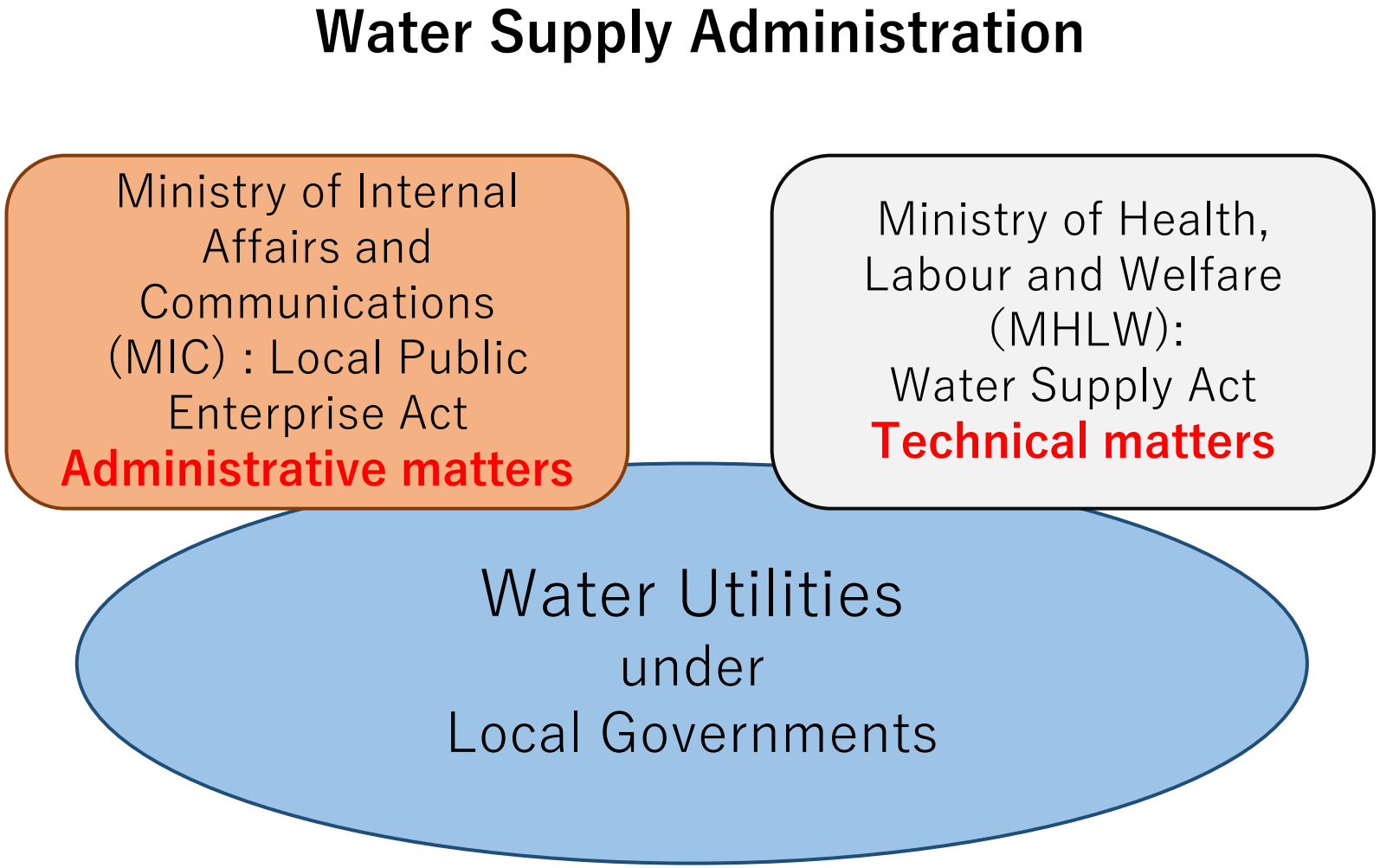
Governance,
Human Resources Development,
Consolidation of water utilities,
Public-Private Partnerships

“Let’s drink tap water with the whole family“

Poster of 58th Water Week in 2016
Source: Japan Water Works Association

No. T7 Ver. 1

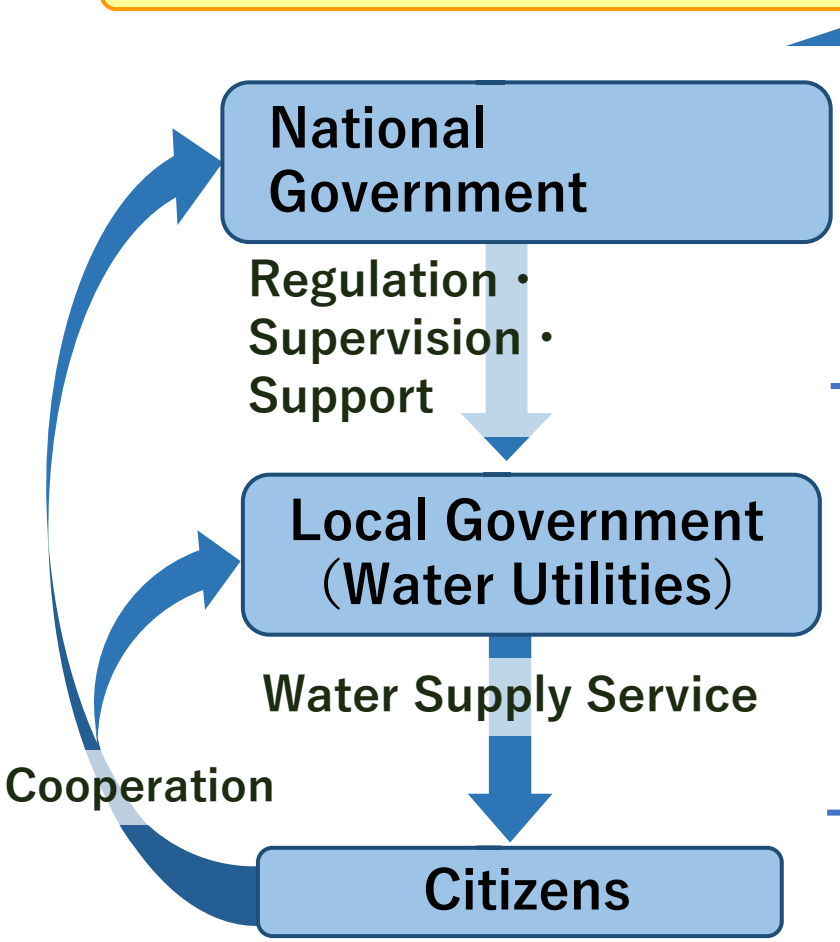
1. Introduction



2. Governance

(1) Roles of the Government, Water Utilities and Citizens

Goal：Water supply for public health and good living environment



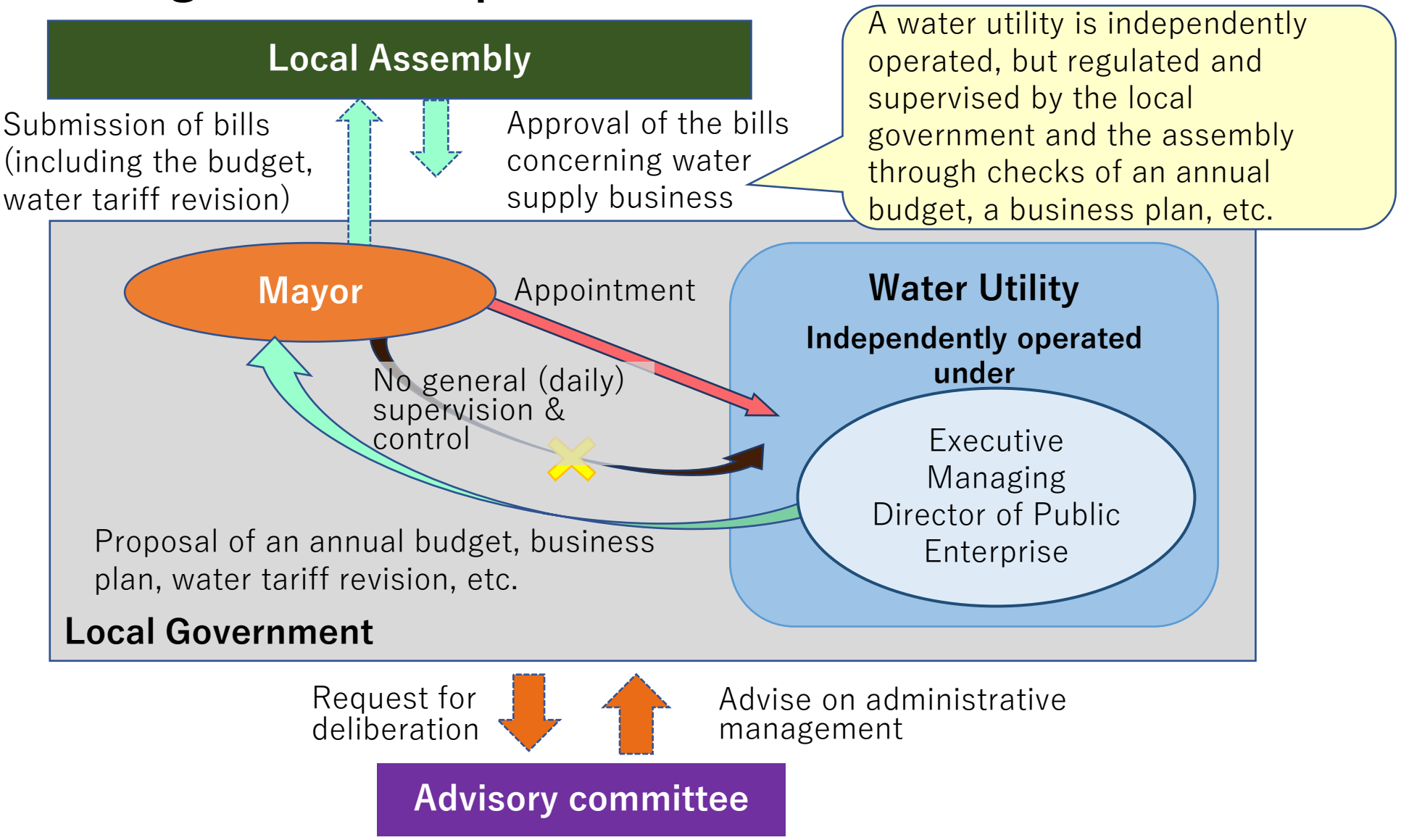
- Basic and comprehensive policies on water resources development and water supply development
- Technical and financial support to water utilities

- Policies/plans on water supply development, proper and reasonable water use, conservation of water sources and maintenance of water supply facilities
- Implementation of those plans
- Appropriate and efficient management of waterworks

- Cooperation with national and local policies
- Proper and reasonable water use

2. Governance

Regulation & Supervision of Water Utilities



2. Governance

(2) Roles of Executive Managing Director & Technical Administrator

Administrative Management

Executive Managing Director of Public Enterprise

- Establishing necessary sections and/or department
- Taking charge of employment/dismissal of employees, wages, work hours and other working conditions, punishment, training, etc.
- Preparing a draft of the budget and the settlement of accounts
- Preparing data for a motion to the local assembly
- Acquiring, managing and disposing assets
- Concluding agreements/contracts
- Collecting tariff, fees other than tariff, contribution, and connection charges, etc.
- Carrying out temporary borrowing

Technical Management

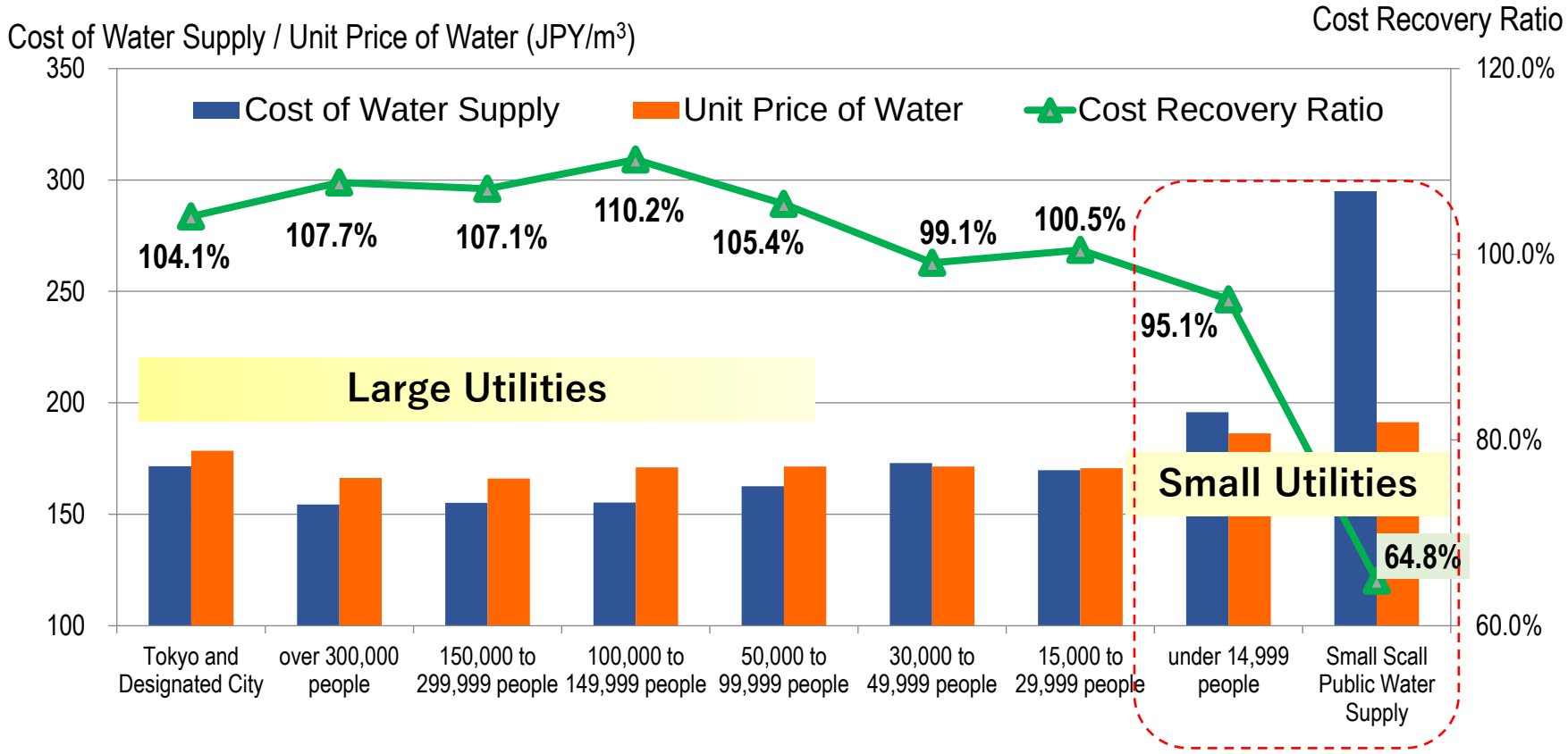
Technical Administrator

- Inspecting water supply facilities based on the standards for facilities
- Conducting water quality inspection and facility inspection
- Conducting inspection of the structure and material of service connections
- Health checkups
- Emergency suspension of water supply

Water utilities have been properly managed under the technical administrators and the executive managing directors of public enterprises

5. Management of Small and Medium Scale Utilities

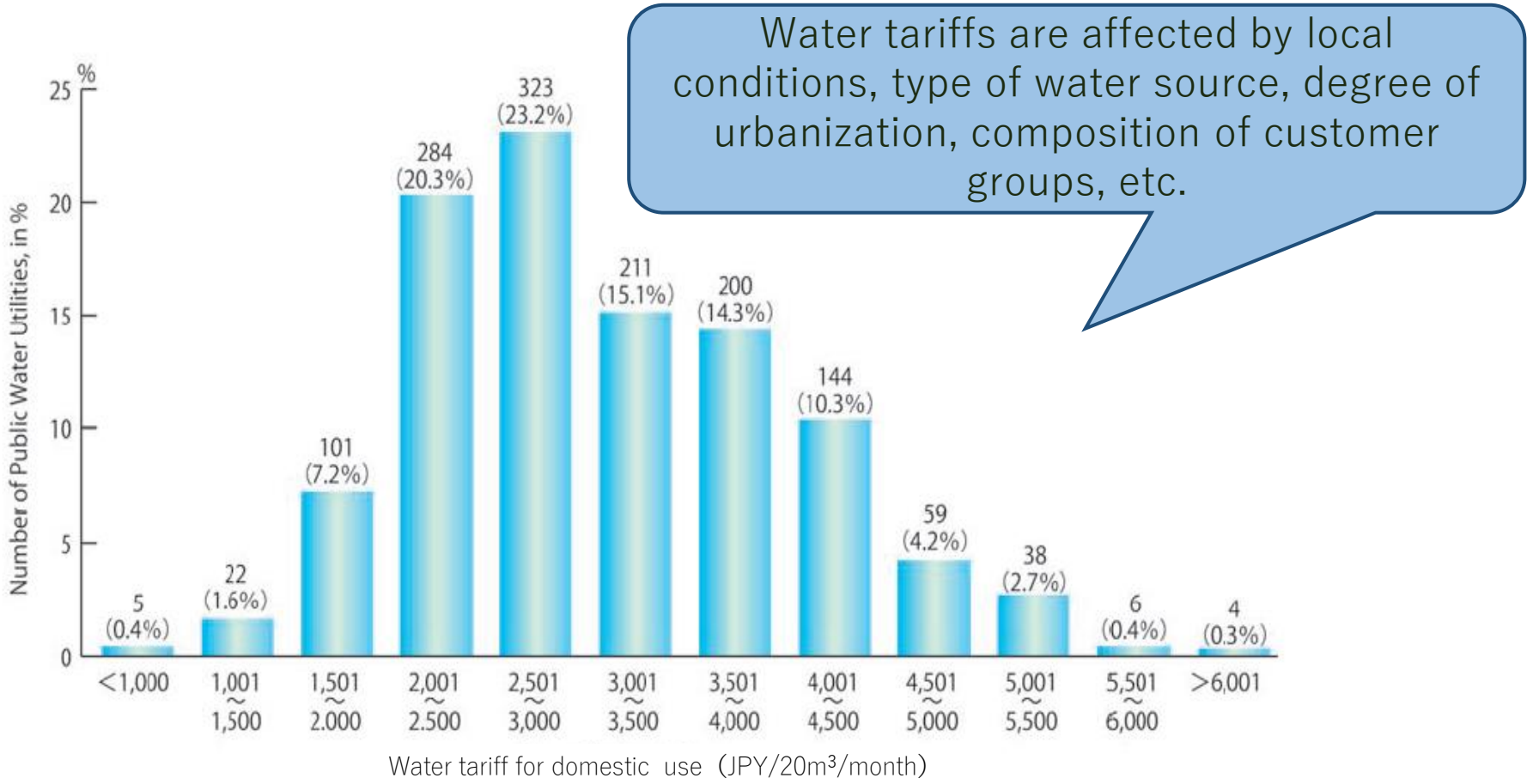
(1) Challenges of Small & Medium Water Supply Management



Source: Created from the data of "*Survey of financial status of local public enterprises, FY 2014*"

Cost recovery in water supply business by size of operation (2014)

5. Management of Small and Medium Scale Utilities



Source: JWWA, *Comfortable Life with Water Supply and Transition of Water Supply Volume*, http://www.jwwa.or.jp/shiryou/water/water.html

Tariff Differential among Water Utilities

5. Management of Small and Medium Scale Utilities

(2) Towards Regional Collaboration

1960s

Rapid increase of water demand, construction costs and water tariffs, deterioration of water sources, inadequate operation and maintenance of small scale water supply

1966

System of “A joint public services authority” was introduced

1977

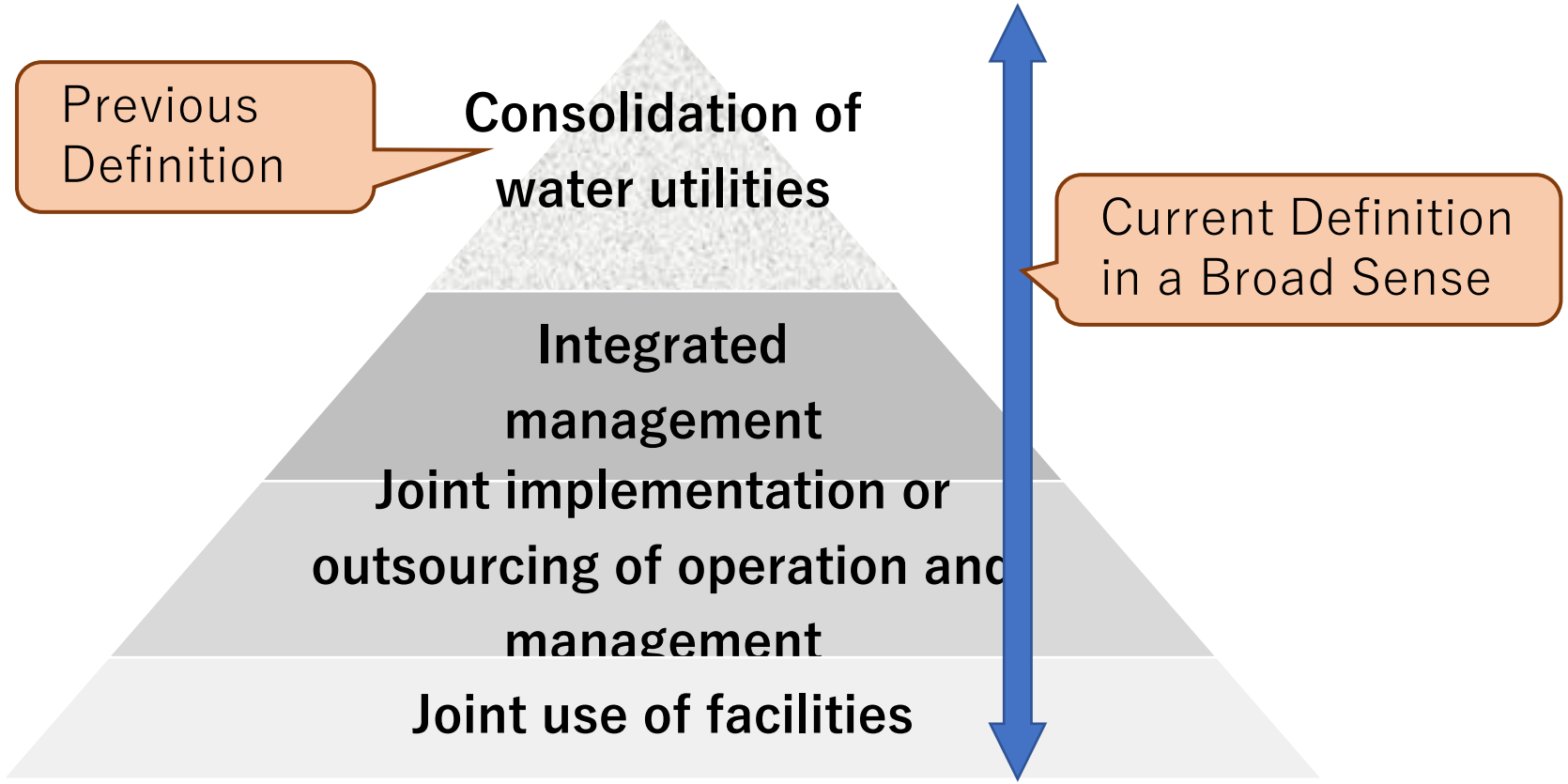
Regional Planning for Water Supply Services was included in Water Supply Act

2000s

Expansion of the concept on regional collaboration

5. Management of Small and Medium Scale Utilities

Previous and New Definition on Regional Collaboration of Water Utilities



Source: JWWA "*Guidelines for the Consideration of Broadening of Water Supply: For the Promotion of Water Supply Vision*"

5. Management of Small and Medium Scale Utilities

(3) Constraints on Consolidation

There are constrains to be overcome in order to consolidate utilities