Guidance for Introducing the Total Pollutant Load Control System (TPLCS)

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Office of Environmental Management of Enclosed Coastal Seas

Water Environment Division

Environmental Management Bureau

Ministry of the Environment, Japan

The overall structure of the Total Pollutant Load Control System ("TPLCS")

Chapter 1 Need for the TPLCS

1.1 Overview of the TPLCS

Water pollution occurs when the balance of nature is lost due to the increase of pollutant discharge load resulting from human activities. A countermeasure for addressing this loss is to reduce pollution load effluent. The Total Pollutant Load Control System ("TPLCS") is an effective scheme for that purpose.

1.2 Structure of the TPLCS

(1) Types of water pollution

Water pollution can be categorized into four main types: health damage caused by harmful substances, problems related to public sanitation concerning bacteria, organic contamination, and eutrophication. The TPLCS principally addresses organic contamination and eutrophication.

(2) Measures for preserving aquatic environment

Measures for preserving an aquatic environment are categorized into source measures, which aim to reduce the amount of pollutant load effluent from sources, and direct purification measures, which aim to purify the environment directly within water areas. The TPLCS focuses on source measures.

(3) Policy measures implemented by the administration and the structure of the TPLCS

Implementing source measures through the voluntary initiatives of emitters is impossible. Some political involvement is needed. The TPLCS seeks to regulate the effluent load released from emitters as well as comprehensively taking various measures, such as the construction of sewage systems, and providing administrative guidance.

1.3 Experiences and lessons of Japan

Along with high economic growth, Japan has seen an increase in pollutant loads, occurring in terrestrial ecosystems and flowing into aquatic systems. Japan has also experienced serious water pollution, which it has overcome through measures such as the TPLCS. It is important to promptly undertake measures where they are most practicable.

1.4 Necessity to introduce the TPLCS

As enclosed water areas have limited water exchange and easily accumulate pollutant load, the need is to reduce and control the total amount of pollutant load. The TPLCS can be utilized as effective pollution reduction measures for those water areas with severe water pollution as well as a method for controlling pollutant load in areas that are expected to be developed in the future. There has been an increasing need for this system as a measure for conserving water quality in countries where economic growth has been accelerating.

1.5 Basic principles of the TPLCS

(1) Basic principles of the TPLCS

To quantitatively measure all pollutant discharge load that flows into water areas, analyze its relationships with the water quality of water areas, set quantitative reduction goals, formulate control plans and, step by step, pursue the measures.

(2) Points to allow the TPLCS to function effectively

It is important to quantitatively control and reduce the pollutant discharge load, formulate total pollutant load control plans for all pollutant load sources from a comprehensive perspective, and pursue reduction and control measures.

Chapter 2　Execution procedures for the TPLCS

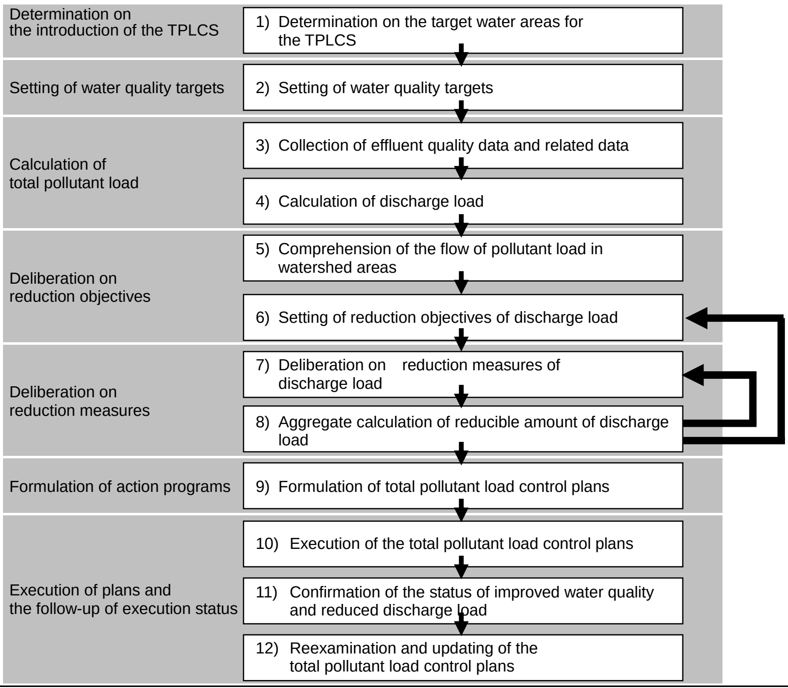
2.1 Definition of pollutant discharge load

In the process of flowing from sources into rivers, lakes/ponds and sea, pollutant loads are subject to natural purification and sedimentation, which lead to change in pollutant discharge load. It is necessary to understand and discuss the pollutant discharge load at each of these stages.

2.2 Overview of the execution procedures

This section describes the execution procedures for the TPLCS.

2.3 The implementation procedures of the TPLCS



2.4 Introduction of the system adapted to local needs and situations

- The TPLCS needs to be adapted to the specific local situations and needs of specific countries.
- Where water pollution is serious, pollution should take precedence over other measures to promptly and infallibly address the sources with more pollution.
- In areas where economic development is expected, the amount of pollutant discharge load should be comprehensively controlled, including the factors contributing to the increase of the load.

Chapter 3　Development of institutions and frameworks for effective operation of the TPLCS

Examination of water quality and status analysis on industrial structure and regional characteristics are needed. Additionally, since the sources vary widely, the requirement is to coordinate and establish cooperative ties with the administrative agencies concerned. Where water pollution is serious, however, the first critical step is to introduce the TPLCS.

3.1 Measurement of water quality

The requirement is to periodically measure the water quality and water flowing volume of rivers, lakes/ponds and sea, and understand the water quality and variations in pollutant discharge load flowing into the water areas.

3.2 Cooperation with agencies and other concerned organizations

The requirement is to coordinate with and secure cooperation from the concerned administrative agencies, and also to coordinate with and secure the links with other parties concerned, including businesses, citizens and local communities.

3.3 Development of institutions and frameworks for administrative supervision over factories and business establishments

The requirement is to develop the institutions and frameworks for mandating that factories and business establishments measure the quality and volume of their effluents and to store related data.

3.4 Promotion of efforts by factories and business establishments to reduce discharge loads

To promote compliance with regulatory standards, the requirement is, in addition to administrative supervision, to combine and deploy policies from a comprehensive point of view in accordance with the conditions in each country, such as those policies for setting discharge load standards, which can realistically be complied with, to provide technical and financial aid, to develop social normative consciousness, to adjust the industrial structure and to rearrange business establishments.

3.5 Implementing measures against domestic effluents

The requirement is to select the optimum method for the measures in consideration of population and population density, housing density, and sewage/Johkasous, and effectively pursue the construction of facilities for domestic effluent treatment. In this process, the need is to formulate plans for treating domestic effluent and systematically implement the plans.

3.6 Other related matters

In addition to promoting survey research on the clarification of pollution mechanisms and development of effluent treatment technologies, the requirement is to secure the necessary funds, foster human resources, and seek to raise the awareness of parties concerned through public information and education/cultivation.

Reference Material

1. Japan’s experience in water pollution and countermeasures
2. Calculating method of pollutant discharge load
3. Overview of Japan’s Total Pollutant Load Control Standards and examples of the method for establishing the standard values
4. Measurement method for the water quality of water areas in Japan
5. Current status of sludge treatment in sewage plants in Japan
6. Status of the water quality in East Asia

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Introduction

In recent years, emerging countries have undergone accelerated economic growth, and that growth has caused mounting concerns over environmental destruction. Economic growth generates wealth for people's lives, but alternatively this growth entails an increase in environmental burden. In the 1960s, Japan attained a yearly average economic growth rate of 9%, but in that process Japan could not deal with the significant increase of environmental pollutant load, and allowed air and water pollution to take place, which led to serious environmental pollution problems, including the degradation of living conditions, fishery damage, and health hazards. For this reason, it became necessary to improve the legal system and to establish an implementation structure for containing environmental pollution, to promote pollution control efforts by businesses and others organizations, to construct sewage systems, and to increase public awareness.

As a countermeasure to address these problems, on the basis of the Water pollution Control Law and the Law concerning Special Measures for Conservation of the Environment of the Seto Inland Sea, the Japanese government decided to implement the TPLCS. The TPLCS aims to reduce the overall inflow amount of pollutant loads, focusing on those enclosed water areas where a large quantity of effluents are released from households and business activities from high concentrations of population and industries, and where effluent control in terms of concentration alone cannot achieve and maintain the Environmental Quality Standards for Water Pollution. The result of these efforts was that Japan could reach a certain degree of accomplishments in improving pollution control and the environment.

In recent years, other countries with significant economic growth are have serious eutrophication of coastal water body from a mass generation of pollutant loads just like Japan in the past. The TPLCS seems effective to cope with this situation, but there are situations where technological and institutional knowledge is insufficient to introduce the TPLCS.

To allow the emerging countries mainly in East Asia, with which Japan has close relationships, to ensure their sustainable economic growth, Japan has been providing aid to these countries for introducing the TPLCS, making use of Japan's experience with the TPLCS, which it has developed. Since April 2009, Japan has been implementing joint research on the total pollutant load control of nitrogen and phosphorus with People's Republic of China. Based on this cooperative initiative, China has decided to include ammonium-nitrogen as a new target item for the TPLCS in China.

Japan has formulated a directive on the introduction of the TPLCS (called "the introduction directive"). This introduction directive provides insights and information that will be helpful both in introducing the TPLCS. The experience and knowledge of Japan and the experience in the joint research with China has provided Japan with the expertise in this introduction directive. The Japanese goal is to ensure effective use of the already introduced the TPLCS. We assume that users of this introduction directive are officials engaged in the administration of the water environment in central and local governments as well as researchers and engineers engaged in the conservation and improvement of water quality.

We believe the insights of pathfinder countries that experienced serious water pollution and responded to the pollution in the past are important for emerging countries, which could draw upon these experiences to improve the water environment. We hope that this introduction directive will be utilized in emerging countries with severe eutrophication problems and contribute to improving water quality. We also hope that the environmental administration both in Japan and other countries will be further developed through these international exchanges.

Chapter 1 Need for the TPLCS

1.1 Overview of the TPLCS

Water pollution is caused by the increase of pollutant discharge loads from population growth, industrial development and economic growth. The natural world exists as a system and has a certain level of self-purification capacity, but water pollution occurs when such increase of pollutant discharge loads caused mainly by human activities breaks the balance of nature. This causes human health hazards, degradation of the living environment, and damage to ecosystems. When water pollution occurs, the need is to reduce the total amount of pollutant load flowing in, and to control in-flow loads after the water environment has been, to some extent, improved. These efforts are called total pollutant load control, and the system for these efforts is the TPLCS.

Reducing pollutant discharge load can be composed of a variety of specific measures such as effluent regulation for factories, construction of sewage systems, night soil treatment, and optimization of livestock waste storage. To efficiently implement these measures and achieve water quality improvement, concurrently with the efforts to ensure the aquatic environment, the need is to quantitatively analyze the effect of these measures on reducing the pollutant discharge load, and to pursue the reduction of pollutant discharge loads from a comprehensive perspective in accordance with plans. The TPLCS seeks to enable these efforts.

In 1973, the TPLCS was first introduced in Japan. At that time water pollution was so exacerbated that the pollution brought damage to fisheries in the Seto Inland Sea, where a total pollutant load control method was first implemented under the newly enacted Interim Law for Conservation of the Environment of the Seto Inland Sea. Implementation led to reducing 50% of Chemical Oxygen Demand (COD) effluent load related to industrial effluent. In 1978, the Water pollution Control Law and the Interim Law for Conservation of the Environment of the Seto Inland Sea were partially amended, and the TPLCS was introduced. The TPLCS aimed to reduce industrial effluent and all other inflowing pollutant loads including domestic wastewater. At present in Japan, the TPLCS is applied only to those water areas called enclosed seas (See Figure 1.2 for the definition of enclosed sea.) into which a large quantity of wastewater flows from households and industrial activities from concentrated population and industry, and where effluent standards (effluent concentration regulations) alone cannot achieve the Environmental Quality Standards for Water Pollution. That is, in addition to the Seto Inland Sea, the TPLCS is applied to Tokyo Bay and Ise Bay, where water pollution is equally prominent. At first, the target item of the TPLCS was limited to COD, but in 2001 it was expanded to include total nitrogen and total phosphorus, which can cause eutrophication. Owing to the regulations on the pollutant discharge load contained in the effluent from factories and business establishments and the implementation of social capital development programs focused on the treatment of domestic wastewater, including the construction of sewage plants, the degradation of water quality in these water areas was restrained. The water quality improved, leading to some improvement of the water quality in some areas of the Seto Inland Sea. Japan has more than 30 years of experience with the TPLCS. During those years it has pursued establishing related institutions and frameworks while at the same time Japan has attained a certain level of improvement and preservation of the aquatic environment.

Figure 1.1 shows the outline of the implementing procedures of the TPLCS in Japan. The TPLCS is highly effective in improving and preserving the aquatic environment due to this systematic structure. The TPLCS can vary in its institutional structure depending on consistency with existing institutions and systems including water quality preservation measures, status of progress, and purpose of introducing the TPLCS in each country.

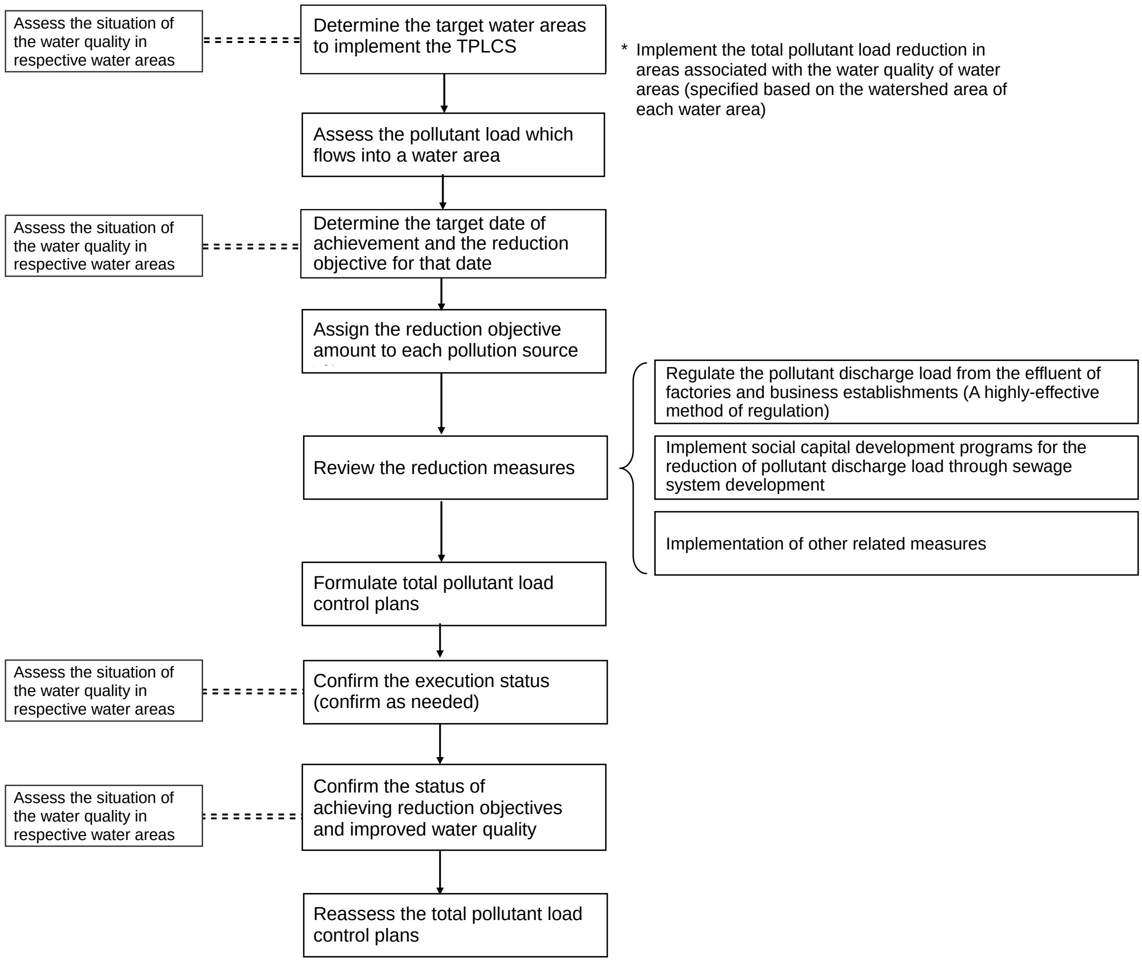

Figure 1.1 Overview of the TPLCS

Japan's TPLCS is utilized as an effective method for reducing pollutant load in enclosed seas where water pollution was especially rampant. The total pollutant load control, however, seeks to reduce and control the total amount of pollutant load which flows into water areas. The TPLCS can be used where pollutant discharge load needs to be reduced to curb the rampant pollution and as a provision to preserve water quality at stages where water quality is not as measurably degraded.

The introduction directive has been formulated so that it could be used as guidance when introducing the TPLCS or when existing systems need to function more effectively. From Japan's experience in the total pollutant load control, we summarized the basics and principles of the TPLCS, with matters to be attended to in using the system in various countries where conditions differ, and sought to make the TPLCS basics and principles adaptable to the needs of other countries.

Definition of the terms used in relation to the introduction directive

Enclosed water area: Water areas are categorized into rivers, lakes/ponds and seas. Among these categories a water area where the water cannot be easily exchanged with outer areas is called an enclosed water area. This includes lakes/ponds and enclosed seas, among others. An enclosed sea is defined in Japan as shown in Figure 1.2. In an enclosed water area, pollutant loads tend to accumulate, and when pollutant loads discharged from human activities increase, they are likely to cause water pollution, making it difficult to preserve and improve the water quality.

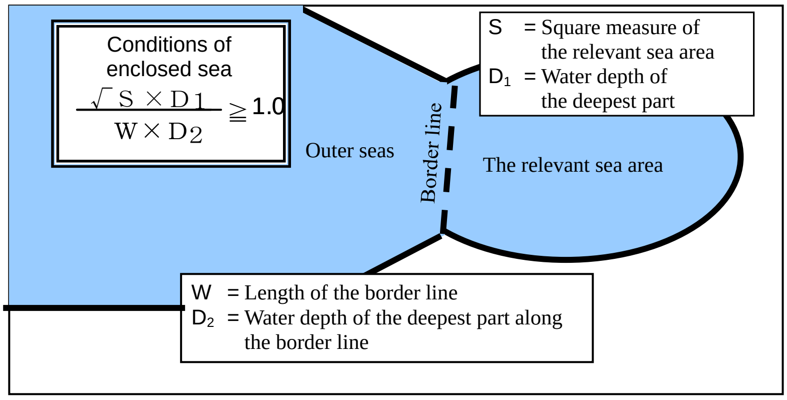

Figure 1.2 Definition of enclosed sea in Japan

The Environmental Quality Standards for Water Pollution: The standards established to preserve the properties of water areas (rivers, lakes/ponds, sea areas) as they should be. In Japan, for instance, the indicators related to the living environment (COD, nitrogen, and phosphorus) are categorized in accordance with water utilization purposes and reference values have been established for these indicators.

Pollutant load: Substances and items which cause pollution of water areas. The pollutant loads addressed in the introduction directive are mainly COD, nitrogen and phosphorus. The quantity of pollutant load is called pollutant discharge load.

Source: Source of pollutant load. Table 1.1 shows the details.

Pollution source: The respective source of pollutant load.

Quantity of pollutant load: Quantity of generated pollutant load.

Discharge load: Quantity of pollutant load discharged into water areas. This is an expression from the point of view of pollution sources.

Inflow load: Quantity of pollutant load that flows into water areas. This is an expression from the point of view of water areas.

Eutrophication: A form of water pollution, where there is an excess inflow of nutrients, which are chemical compounds of nitrogen and phosphorus, from watershed areas. This situation leads to a serious proliferation of plankton and algae, and a variety of hazards including the extinction of aquatic organisms and drinking water hazards.

1.2 Structure of the TPLCS

This section describes the role of the TPLCS among various efforts to preserve the aquatic environment.

(1) Types of water pollution

Water pollution is caused by industrial development concentration, urbanization, and population increase and concentration, which accompany economic growth. Although nature has purification capacity, water pollution results when the discharged amount of pollutants increases from population growth and industrial effluents and surpasses the natural purification capacity. Alternatively, alteration of nature by acts of development such as landfilling of coastal areas or destruction of vegetation on river banks and swamps may sometimes affect this natural purification.

Water pollution can be categorized into several types in terms of the effects and mechanisms.

The first type is pollution that directly harms human health from heavy metals and harmful chemical substances discharged into water areas. This first type also affects aquatic organisms in such a way as to cause malformation, debilitation and the death of fish. Harmful heavy metals and chemical compounds that generate such damage include many substances such as cadmium, lead, hexavalent chromium, quicksilver, arsenic, polychlorinated biphenyls (PCBs), and cyanide. These substances are discharged from mining and manufacturing industries and used as agrichemicals and herbicides, but these are specified as the target substances of environmental quality standards for water pollution in respective countries, and are regulated or prohibited based on their hazardous properties. In addition, there are also naturally-derived pollutants drained from groundwater.

The second type of pollution causes public health problems due to bacteria in such a way as to allow infectious diseases including dysentery and cholera to occur. Infectious diseases occur and damage human health when treatment of domestic effluents including night soil is inappropriate, and the effluents are discharged as they are without any treatment, or when they get mixed with drinking water. Therefore, a thorough treatment of night soil and a full separation of the city water supply from sewage systems are implemented. In Japan, the law requires that night soil is treated in one of three ways. Night soil is taken into the sewage system, released into rivers after treatment in Johkasous[1], or collected from dip-up toilets and centrally processed.

The third type is organic contamination. The extent of organic contamination is expressed by indicators such as Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), and Total Organic Carbon (TOC). Organic matter flows in from the natural world by way of corrosion and animal corpses and also can be found in domestic drainage and industrial effluent from factories in various sectors, and water pollution occurs particularly due to the increase of discharge loads from these human activities. Organic matter contained in water areas is decomposed by aquatic organisms and in this way the aquatic environment is maintained. If organic matter flows in quantities beyond the decomposing capacity, pollution progresses and water quality is cumulatively degraded. At the same time the transparency is gradually reduced, and water begins to exude a foul odor and changes from the natural color to green, brown or reddish brown. In this way, difficulties in water utilization occur in the form of drinking water hazards and fishery damage, and the living environment is progressively contaminated. Additionally, insoluble organic matter accumulates on the beds of lakes, streams and seas as sludge. To reduce these inflow loads of organic matter from these effluents, individual countries implement laws to regulate these problems.

The fourth type is eutrophication, which is related to organic contamination described in the preceding paragraph on the third type. Eutrophication is from nutrients, which are compounds of nitrogen and phosphorus, flowing in from watershed areas. Plankton and algae proliferate abnormally and consume dissolved oxygen in water. The deficiency in oxygen causes aquatic organisms to wither away and generates various difficulties in water utilization in the form of worsened living environment, influences on fishery resources, and drinking water hazards. Algae and plankton may produce harmful substances. Abnormal occurrences of plankton cause red tides and debilitation and the death of fish, which will be deposited on the bottom sediment, causing oxygen-deficient water masses on the bottom layer. The oxygen-deficient water then causes serious influences that result in debilitation and the death of benthic organisms including shellfish.

Essentially, nutrients, which are compounds of nitrogen and phosphorus, are needed to maintain eco-systems, but eutrophication occurs when the supply-consumption balance of nutrients is lost and nutrients become redundant. Especially in those water areas where the residence time of water is long, namely in enclosed seas, lakes/ponds and rivers (called “enclosed water area(s)”), and where the flow is slow and water tends to reside for a long time, nutrients are likely to easily accumulate and the aquatic environment becomes vulnerable to eutrophication. For these reasons, we need to

1 Johkasou is an on-site treatment system of domestic effluent, installed at each household mainly in rural areas with low population density. Its treated water（Effluent BOD $\leqq$ 20mg/l） is discharged to the nearest public water area, and its sludge collected by vacuum truck is treated and recycled in night soil treatment facility.

control or regulate the total amount of nutrients that flow into enclosed water area. The requirement is to reduce and manage their total amount.

The main pollutants that need to be addressed under the TPLCS are organic matter that leads to organic contamination and nutrients that lead to eutrophication.

Various types of organic matter and nutrients are discharged from a number of sources into water areas. The main sources are shown in Table 1.1.

Table 1.1 Main sources of pollutant load

	Main sources of pollutant load	Characteristics
(1) Industry-related	Factories and business establishments including hospitals, hotels and inns, canteens, laundries, bathhouses, gas stations, automobile repair shops, and poultry dressing plants.	Generated pollutant discharge load increases along with the expansion of economic activities and industrial production.
(2) Human life-related	Human life (Domestic effluents are categorized into night soil and other domestic effluents (called domestic wastewater). Domestic wastewater is generated by cooking, laundry, bathing, and cleaning.)	Generated pollutant discharge load increases along with population growth and concentration in urban areas. The amount also changes in accordance with lifestyles, living standards and living habits including toilet types (flushing, dip-up) and frequency of bathing.
(3) Livestock-related	Livestock manure of cattle, horses, pigs, poultry and other animals. Cleaning water for livestock barns.	Generated pollutant discharge load increases along with the size of livestock.
(4) Agricultural land	Fertilizers and agrichemicals not absorbed in crops, and organic matter such as dead branches and leaf debris left on the farmland.	Generated pollutant discharge load increases along with the amount of chemical fertilizers applied. The pollutant load is discharged into water areas by rainfall.
(5) Built-up areas	Accumulated mote, leaf debris and trash.	The pollutant load is discharged into water areas by rainfall.
(6) Forest land	Decayed vegetation.	The pollutant load is discharged into water areas by rainfall.
(7) Aquaculture	Leftover feedstuffs in aquafarming and dead fish.	

In addition, sources of pollutant loads are now categorized in terms of whether it is possible to identify the occurring place. Identifiable sources are called point sources, and unidentifiable sources because the pollution occurs over a plane are called plane sources (also called non-point sources). These terms are used in this introduction directive.

Point and plane sources are addressed differently under policy approaches for reducing pollutant discharge loads. As the occurring places of point sources can be identified, discharge loads can also be measured, and effluent regulation can be implemented based on those loads. For plane sources, however, this method is not applicable because occurring places cannot be identified.

Point sources include (i) large-scale industrial sources, (ii) domestic sources with domestic effluent treatment facilities, and (iii) large-scale livestock sources. Alternatively, plane sources include (iv) small-scale industrial/domestic/livestock sources not included in point sources, (v) farmlands, (vi) built-up areas, (vii) forest lands and (viii) aquaculture.

As shown in Table 1.1, pollutant loads also occur in the natural world and flow into water areas, where ecological cycles take place and promote natural purification and biological ingestion, forming stability in the natural world. However, if pollutant discharge loads generated by human activities such as population growth, expansion of industrial production, increase of livestock, and increase of chemical fertilizer inputs, are left to increase, they will eventually surpass the natural environmental capacity. This would lead to the degradation of aquatic environment and cause water pollution. When the economy grows and production capacity expands, pollutant discharge loads must be addressed. The requirement is to pursue the compatibility of economic and social development with environmental conservation.

The TPLCS seeks to realize the compatibility of development and environmental conservation by efficiently implementing the reduction measure of discharge loads.

(2) Measures for preserving aquatic environment

Measures for improving water quality can be classified into two types. One type is measures to reduce the pollutant discharge load into any water area (a source measure). The second type is measures to purify the water area itself, where water pollution has already progressed, and the pollutant load, which has already been discharged, within the concerned water area (a direct purification measure).

Implemented source measures include effluent treatment to reduce pollutant loads and reduction of the use of raw materials and materials containing pollutant loads. Implementing methods of effluent treatment include, for instance, treating effluents in a wastewater treatment facility constructed in a factory, and collecting domestic effluents through sewage systems and treating the effluents in centralized sewage treatment facilities[2]. Additionally, soap powder and phosphorus-free

[2] Effluent treatment is needed when discharging effluents into water areas including rivers and seas and when allowing the effluents to penetrate into the underground. If effluents containing much

detergents, for instance, instead of phosphorus-containing detergents, can be used to reduce the use of raw materials and materials containing pollutant loads.

For direct purification, possible measures include dredging (directly removing the pollutant loads accumulated on the water bottom), utilization of swamps and tidal flats, aeration (injecting oxygen or air into water areas), and water intake for water purification (water intake from other water systems where pollution has not progressed).

Direct purification measures address already discharged pollutant loads and thus have a secondary role as a countermeasure against water pollution. The TPLCS aims to reduce the total amount of pollutant loads and focuses on source measures.

(3) Policy measures implemented by the administration

Since implementing source measures, such as installation and the operating costs of effluent treatment facilities, generates costs, simply expecting polluters to take self-initiatives may not necessarily lead to adequate responses. Therefore, policy involvement will be necessary, and administrative measures are pursued as shown in Figure 1.3.

The total pollutant load control plan seeks to comprehensively take these measures, as well as to implement highly effective total pollutant load control on discharge loads, and to pursue the improvement of water quality of the concerned water areas. An overview of the relationship between administrative policies on total pollutant load control and the TPLCS is shown below, focusing particularly on parts related to source measures.

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pollutant load are allowed to penetrate into the underground, they will cause groundwater contamination, and the pollutant load will be delivered to lakes/ponds and seas after a long time via groundwater. Then the pollutant load may occasionally generate water pollution for a long period of time.

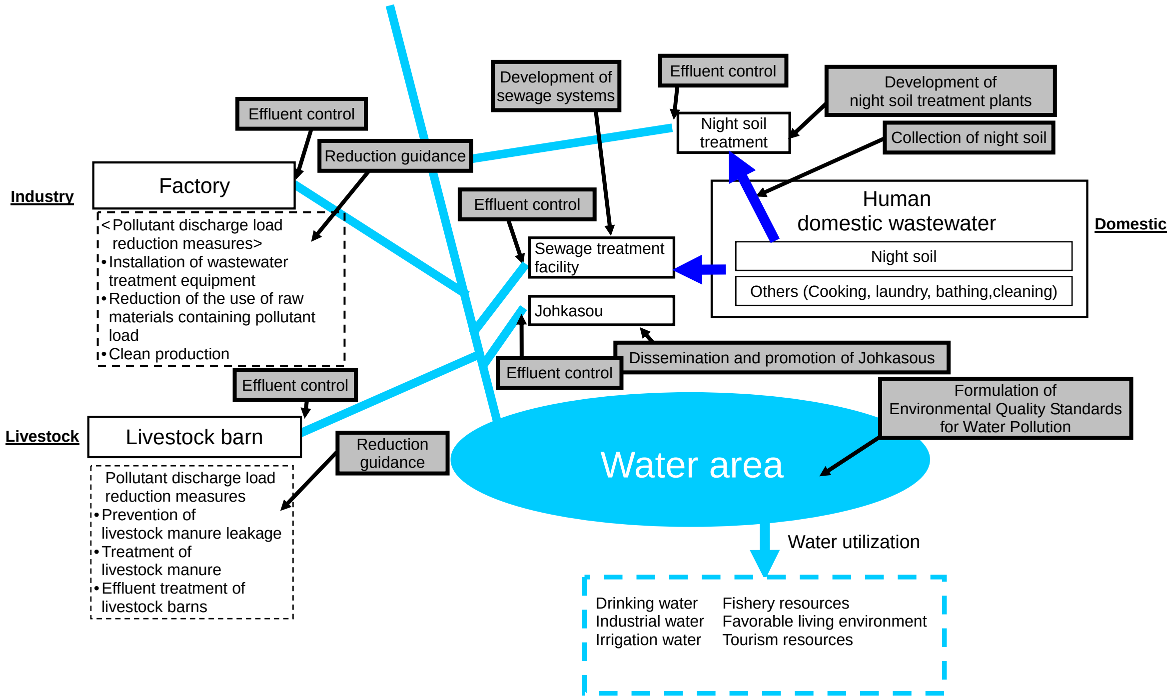

Figure 1.3 Structure of source measures

i) Formulation of the Environmental Quality Standards for Water Pollution

These standards establish the criteria for the water quality of water areas (rivers, lakes/ponds, seas). The Environmental Quality Standards for Water Pollution are an administrative objective. When the standards are met, efforts are required to preserve the aquatic environment, while if they are not met additional efforts are required to meet them. In Japan, the Environmental Quality Standards for Water Pollution address a total of 37 items. The items are categorized into the environmental water quality standard for protecting human health (27 items: harmful heavy metals and chemical substances such as cadmium and cyanides are addressed) and the environmental water quality standard for protecting living environment (10 items: COD, BOD, dissolved oxygen, total nitrogen, total phosphorus, coli group are addressed). The environmental water quality standard for protecting human health has been formulated uniformly for all public waters in Japan. The environmental water quality standard for protecting living environment has several categories in accordance with the water utilization purpose of each water area. Different standard values are set for the categories.

The TPLCS mainly addresses organic contamination and eutrophication, and the Japanese TPLCS addresses COD, total nitrogen, and total phosphorus. These items are addressed by the environmental water quality standard for protecting living environment, for which the Environmental Quality Standards for Water Pollution are established in accordance with the respective water utilization purposes of water areas. In this way, total pollutant load control seeks to secure water quality corresponding to the water utilization of water areas.

ii) Regulation on the discharge of effluent water

Industrial effluents from factories and business establishments and large-scale livestock barns are regulated by effluent control to reduce the discharge load. The regulated factories and business establishments are required to take measures to meet the effluent standards, and the discharge load is expected to be reduced by implementing those measures. Effluent control is also implemented in large-scale livestock barns, residential estates and sewage plants in addition to factories and business establishments.

One of the most commonly used effluent control measures is emission concentration regulation that regulates the concentration of pollutant load contained in effluents. Measuring the effluent concentration of a business establishment can promptly determine if each business establishment meets the rules. Consequently, comparatively little effort is required to implement the regulation.

However, where a considerable increase of effluent load is expected from the construction and expansion of factories, effluent concentration regulation alone may not be able to prevent the increase of the total amount of pollutant load flowing into water areas. In such cases, total pollutant load control will be necessary to reduce the amount of pollutant load. (In the text below, the regulation standards on pollutant discharge load for the total pollutant load control is referred to as "Total Pollutant Load Control Standard.")

Under the TPLCS, a basic principle is to establish standards for pollutant discharge load and implement total pollutant load control.

As the pollutant discharge load of effluents can be expressed by multiplying the concentration by the amount of effluents, to implement total pollutant load control, the requirement is to measure the concentration and amount of the effluents. More time and effort are necessary to implement total pollutant load control than effluent concentration regulation, but this is an effective, secure method when the pollutant discharge load must be strictly controlled and managed.

iii) Promotion of domestic effluent treatment

Since general households are also among the sources of pollutant loads by discharging domestic effluents including night soil, they require implementing domestic effluent measures. Japan prohibits discharging untreated night soil into water areas from a standpoint of preventing infectious diseases, but does not directly regulate the domestic effluents from kitchens, baths, and laundries other than night soil (called "domestic wastewater").

As measures for treating domestic effluents, local authorities are conducting sewage system development programs, combined treatment in residential estates, and installation of Johkasous for general households. All these methods employ aerobic treatment systems combining night soil and domestic wastewater.

Sewage systems are constructed mainly in urban areas with high population density, and small-scale sewage systems are constructed in residential estates and concentrated farm villages by the unit of residence blocks and villages. In areas with low population density, Johkasous are constructed by each or several households.

Sewage systems are usually regarded as a social infrastructure, and their construction is conducted by public organizations as the operating body. However, for sewage systems for each household, construction is often conducted under the responsibility of individual persons. In these cases, policies are used as needed, including technical guidance and subsidies for promoting the construction. In Japan, local governments construct a Johkasou for each household, and conduct projects to maintain and manage the systems.

The TPLCS calculates the effect of these policies for reducing pollutant discharge load, and pursues the implementation of effective policies.

iv) Guidance for reducing pollutant load

The administration gives technical guidance for pollutant load sources to reduce pollutant load. This is an effective way to capture the pollutant load sources which sometimes slip from regulations. For instance, this could include guidance on applying chemical fertilizer to reduce the pollutant discharge load from farmlands, and guidance on the technology for small-scale business establishments, such as home-craft industries to remove pollutant load. Under the TPLCS, in cooperation with the administrative sectors concerned, reduction guidance is developed for a variety of pollutant load sources.

v) Other related policies for promoting source measures

Promotion policy is under way, including policy lending, subsidies and tax benefits to induce factories to install effluent treatment facilities. In addition, dissemination of knowledge and promotion of environmental awareness are pursued through education and public awareness activities.

(4) The structure of the TPLCS

The TPLCS regulates pollutant discharge load for pollutant load sources where effluent control is possible, and seeks to deploy other various policies and methods for pollution reduction comprehensively. The TPLCS requires coordination with concerned administrative units. Sharing the recognition in the process of this coordination may be possible. Meanwhile, it is possible to formulate efficient plans by considering the feasibility, implementation cost, time needed to implement the measures, and effect of reducing pollutant discharge load of various policies.

The schematic structure of the TPLCS in Japan is as shown in Figure 1.4.

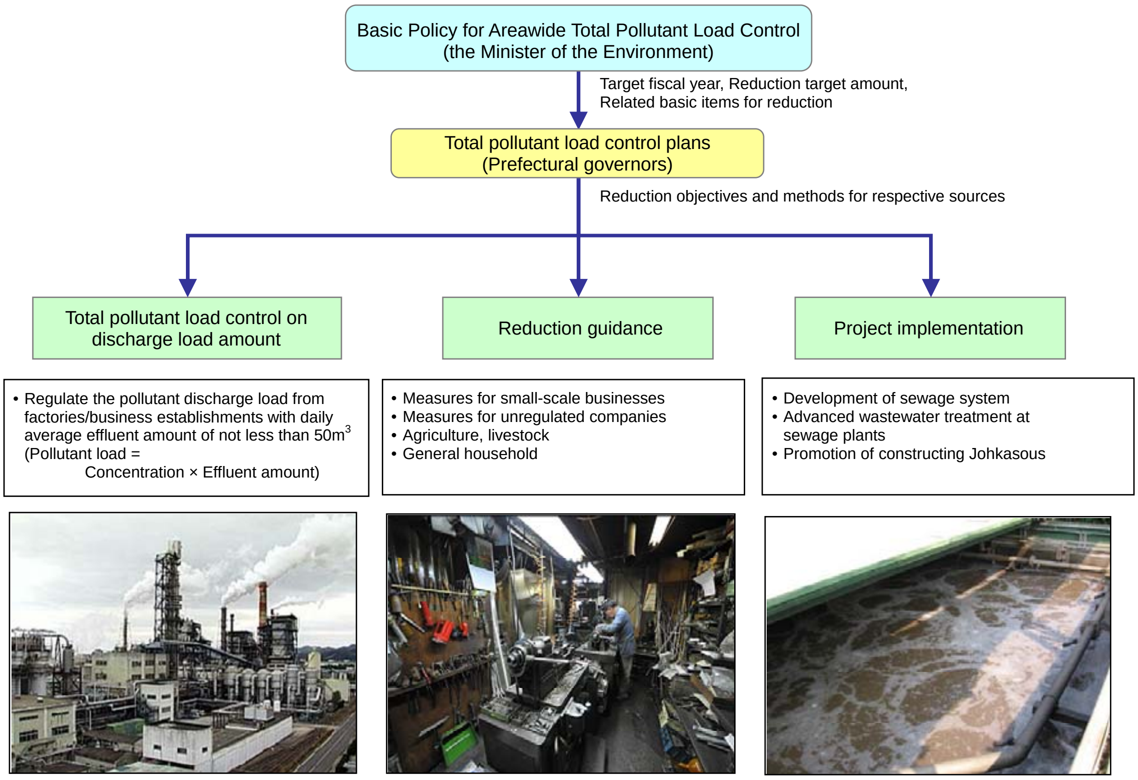

Figure 1.4 Schematic structure of the TPLCS in Japan

Column 1: Regulation on the discharge of effluents in Japan

In Japan, national uniform effluent standards (concentration standards) have been created for all factories and business establishments, and related facilities are regulated accordingly. Where national uniform standards cannot be expected to adequately preserve the aquatic environment, each prefecture can establish ordinances with stricter effluent standards in addition to the national uniform standards. For those enclosed seas where the Environmental Quality Standards for Water Pollution cannot be expected to be met even with these ordinances, the TPLCS is applied and an effluent control method called “total pollutant load control” is adopted. This method is a form of regulation on the amount of pollutant discharge load. In Japan, the TPLCS is regarded as a means to address enclosed seas with severe water pollution from an institutional standpoint. Even when prefectures add stricter standards, the reference values for the additional standards are decided based on the concept of containing the pollutant load discharged into water areas within a certain range for the purpose of preserving the aquatic environment. This concept incorporates the idea of controlling the total amount of pollutant load.

Figure 1.5 shows this institutional system of the Water Pollution Control Law and the structure of the TPLCS under the Law.

The Japanese systems are as described, but some countries regulate pollutant discharge load nationwide, and pursue the reduction of pollutant discharge load.

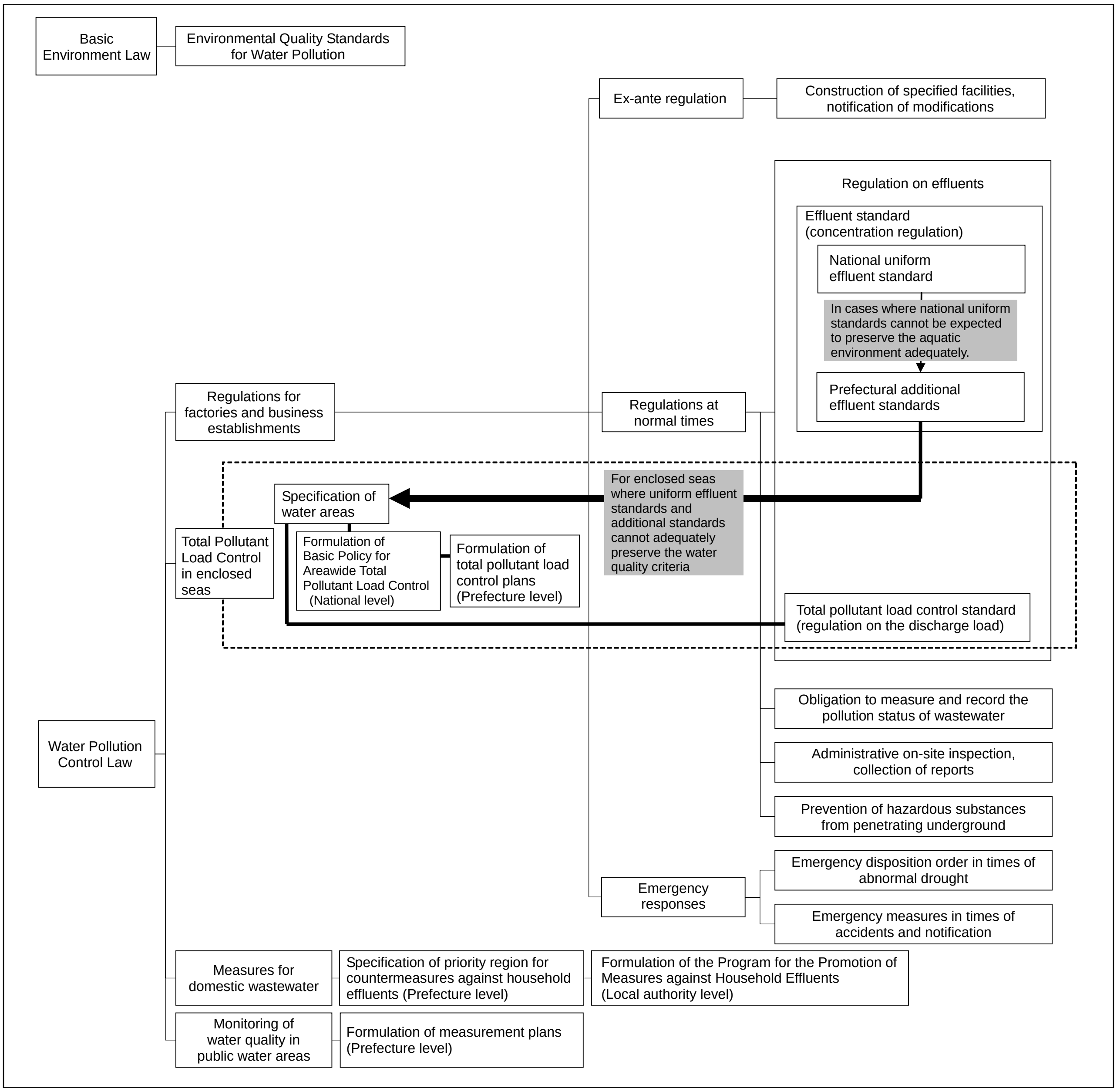

Figure 1.5　The system of Water Pollution Control Law and the structure of the TPLCS in Japan

* In Japan, the Environmental Quality Standards for Water Pollution is stipulated in combination with other environmental standards including the standards for ambient air. These are also shown in Figure 1.5.

1.3 Experiences and lessons of Japan

Japan saw a rapid increase in its economic growth at an yearly average rate of 9% from the late 1950s to the beginning of the 1970s. This rapid increase caused an increase in industrial production and population concentration, which entailed a considerable increase of pollutant load beyond any countermeasures, leading to serious water pollution that further caused damage to fishery by red tide and deterioration of living environment with foul-smelling drinking water and an offensive odor[3]. Faced with escalating environmental pollution, however, public sentiment called for countermeasures against the pollution. Gathering momentum for the movement, the public urged the legal system to be upgraded rapidly from around 1970, and intensive countermeasures were implemented. In the process, to preserve the environment of the Seto Inland Sea, which was called "The Dying Sea," because of severe water pollution, particularly with red tide causing fishery damage, in 1973, the Interim Law for Conservation of the Environment of the Seto Inland Sea was enacted by lawmaker-initiated legislation[4]. This legislation began to reduce (by 50%) the total amount of industrial pollutant load (COD) in the Seto Inland Sea in 1974. In addition, the TPLCS, which sought to reduce the total amount of pollutant load including industrial effluent and domestic effluent, was introduced in 1978, and this was applied to the Seto Inland Sea, Tokyo Bay and Ise Bay. Through these measures, the degradation of water quality was suppressed, and the situation has been improving since then (Water pollution in Japan and the countermeasures are described in Reference Material 2.).

Japan's experiences and lessons can be summarized as follows:

i) Implementation of water pollution countermeasures from the standpoint of prevention

Measures for the preservation of water quality need to be initiated from the standpoint of prevention. As Japan could not adequately address environmental pollution in the process of industrial development, water pollution was aggravated and countermeasures were belated, so that more time and cost were necessary to cope with the pollution. If an increase of pollutant discharge load is foreseen due to economic growth and population increase, the need is to promptly initiate countermeasures from the standpoint of prevention. At present, scientific insights and technologies on the environment have advanced in comparison with those in the 1960s, and now it is actually possible to apply preventive measures.

ii) Development of the TPLCS based on experiences, scientific insights and change in social conditions

It is important to initiate measures for total pollutant load control that can be implemented as far as practicable even if all the functions and logic have not been made clear. Also important is to strive to accumulate experience and scientific insights, utilize the accumulated information, and develop the TPLCS in light of the change in social conditions. When the TPLCS was first employed in Japan

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[3] Japan's per capita GDP was $3,170 (price-adjusted) in 1965. At that time, the economic growth rate and the economic development stage were similar to those in the current China and Southeast Asian countries.

[4] In Japan, lawmaker-initiated legislation is the term for enacting a law through the initiative of members of Diet. The Law concerning Special Measures for Conservation of the Environment of the Seto Inland Sea was enacted as requested by the regions facing the Seto Inland Sea through this lawmaker-initiated legislation.

in the 1970s, it was recognized that a multiple of challenges remained, but these were addressed in the course of implementing the concerned measures. It is considered to have been a principal driving force that the stakeholders had a common view that it was critical to initiate the TPLCS first in order to prevent further aggravation and improvement of the aquatic environment. They had strong enthusiasm for solving the remaining challenges.

Japan has experienced many trials and errors because it was a pathfinder in terms of environmental pollution, but today it is possible to learn from the success and failure of pioneers. The need is to effectively utilize those experiences and pursue the efforts.

The pollution mechanism of water areas has scientifically advanced as compared with previous knowledge. Combined with the development of wastewater treatment technologies including those for removing nitrogen and phosphorus, various countermeasures have begun to be employed. It is significant to make use of these experiences, knowledge and scientific insights accumulated in this way, and to pursue measures for preserving water quality.

1.4 Necessity to introduce the TPLCS

Since the turn of the twenty-first century, there has been rapid economic growth and population increase in Brazil, Russia, India and China (BRIC) and in East Asia, South Asia, Middle East, Africa and Latin America. In these countries, some urban water areas already have serious water pollution. Because of a considerable increase of pollutant discharge load foreseen in the future, even in water areas where water pollution is not a significant issue, a matter of concern is that water pollution may occur or become worse in the future (The situation in East Asia is summarized mainly in Reference Material 6.). Above all, preservation of water quality is a critical issue for those water areas that have drinking water resources and ample fishery resources. Taking steps as soon as possible is important because once water pollution reaches a critical level from belated countermeasures, time and funds are required to address water pollution.

In line with economic and social development, implementation of a full-scale measure such as a comprehensive domestic effluent treatment is required, which includes the installation of wastewater treatment facilities in factories and construction of sewage systems. Consequently, it is important to share the recognition of the significance of water pollution countermeasures with the administrative sectors concerned and the general public, to take effective measures at an early stage, and to pursue efficient measures as a whole. In the course of making these efforts, the TPLCS is an effective method, and its use will be a valuable option.

The TPLCS can be utilized in the following ways.

i) For those water areas where water pollution is already at a serious level, the TPLCS can be utilized as an effective measure for reducing pollutant load.

Under this circumstance, “reduction” is emphasized. The TPLCS is expected to improve water quality in a reliable manner because it applies regulations including the total pollutant load control to those pollution sources whose pollutant discharge load can be clearly understood such as industrial effluent, and in that way it seeks to reduce the pollutant discharge load. Because the TPLCS pursues various measures from a comprehensive perspective, efficient reduction measures can generally be implemented.

ii) This TPLCS can be utilized as a preventive method for managing pollutant load in areas where future development is expected.

Under this circumstance, management is emphasized. Even in those water areas where water pollution has not reached a critical level, if population increase or promotion of industry is envisioned due to watershed development in the future, water pollution is expected to become worse. Water pollution needs to be minimized through preventive measures because time and funds are required to restore the aquatic environment. The TPLCS seeks to manage all sources of pollutant load flowing into the water area, and can be utilized as a comprehensive method for managing the pollutant discharge load in these watershed areas.

In those enclosed water areas where the flow is slow and the residence time of water is long, such as in enclosed seas, lakes/ponds and rivers, water is not likely to be exchanged with the water of outer areas and pollutant loads are likely to easily accumulate. Consequently when considering the countermeasures against organic pollution and eutrophication, the need is to reduce or manage the total amount of pollutant load. The concept of total pollutant load control is needed for aquatic environment measures in enclosed water areas. Introducing the TPLCS is important.

1.5 Basic principles of the TPLCS

After introducing the TPLCS, it needs to be allowed to function effectively. For that purpose, the requirement is to make efforts based on the basic principles of total pollutant load control. The TPLCS seeks to preserve or improve the water quality of the concerned water areas by reducing and managing the pollutant load that flows into the water areas. The TPLCS basic principles are as follows:

i) Ensure that all pollution sources in industrial, domestic, livestock and agricultural sectors that flow into the water area are included in the target items for calculating and reducing pollutant load.
ii) Quantitatively assess the total amount of pollutant load.
iii) Determine the pollutant discharge load and establish the reduction objective for preserving adequate water quality of each water area through measuring the water quality and flow

volume of the target water areas or rivers flowing into the target water area. For the reduction objective, establish a quantitative reduction objective in accordance with the defined target date, and determine and assess the reduction performance quantitatively. When establishing the reduction objective, the projected increase of pollutant discharge load from industrial development and population increase should be considered.

iv) When reducing the pollutant discharge load from point sources such as factories and business establishments, adopt a reduction method by which pollutant discharge load can be reduced.

v) Formulate total pollutant load control plans incorporating various measures to be implemented for the purpose of attaining the reduction objective.

Some steps may be omitted if emergent measures need to be implemented for water areas where water pollution has been rapidly worsening, and when pollution control is likely to take too much time and may not serve the purpose if all measures are implemented based on the five principles.

For instance, when it takes time and effort to address all pollution sources, it may be possible to begin with those sources with a larger proportion to the overall pollutant discharge load than others. (As described in Section 1.3, the total pollutant load control method was first implemented for industrial effluent in the Seto Inland Sea in 1974, and a new system has been employed for all sources since 1979. In the Seto Inland Sea, the belief is that approximately 80% of the pollutant discharge load in effluent was from industrial sources in 1972.)

Similarly, when trying to quantitatively evaluate the total pollutant load, there are cases where it may be difficult to calculate the load with high precision due to the absence of actual data and related statistical information required for the calculation at the stage of introduction. If the aquatic environment of a water area is severely polluted and the pollutant discharge load has to be promptly reduced, a reduction objective should first established for the discharge load from those sources for which reduction measures can be implemented. Then it may be possible to implement the reduction measures. In such a case, the need is to measure the discharge load and quantitatively assess the reduction amount while implementing the reduction measures. In the course of these efforts, enhancement of actual data and related statistical information is to be pursued. In addition, systems and frameworks are to be developed for actual measurement and record keeping of the water quality. Through these efforts, the total amount of pollutant load can be determined.

As mentioned above, to implement the TPLCS, the actual conditions of industrial structure, regional characteristics need to be known by examining the water quality. Since total pollutant load control is built on the basic concept of addressing all sources of pollutants, related administrative sectors cover a broad range, and it is important to coordinate and establish a cooperative relationship with the sectors concerned. The systems and frameworks required to implement such total pollutant load control are described in Chapter 3.

The following two points are critical to allow the TPLCS to function effectively:

i) Manage and reduce pollutant discharge load in a quantitative manner

> The TPLCS is based on the above concept. The TPLCS must proceed with the measures "quantitatively," through which the discharge load is to be reduced and managed with certainty, and lead to the preservation or improvement of the water quality of water areas. One principle is to quantitatively establish the reduction objective, and to evaluate the result of the reduction measures, for which it is necessary to determine the pollutant discharge load and the water quality of the water area quantitatively, and develop the systems and frameworks for the efforts.

ii) Establish total pollutant control plans for all sources of pollutant load from a comprehensive point of view, and implement the reduction and management plans.

> At a stage where immediate reduction measures for discharge load are required due to the severity of the pollution level of water quality, as stated above, rather than taking time to address all the pollution sources, the priority is sometimes to initiate the related measures as soon as possible, paying attention to the sources that account for a higher proportion in the total discharge load. However, to preserve the water quality of water areas, the primary principle is to assess the total quantity of pollutant load flowing into the water areas and to manage the load, as well as the basis for making rational total pollutant load control plans.

Chapter 2 Execution procedures for the TPLCS

In this section, the procedures and methods for implementing the TPLCS will be explained, with reference mainly to the procedures adopted in Japan. It is important for the TPLCS to adopt those procedures and methods that are adapted to the conditions, practices, priority subjects and needs of each country or area, and to review them for each country and area based on the basic points.

Also in Japan, the TPLCS has been developed over the years, while issues such as the survey research on the situation of water pollution, discharge load reduction technologies, measurement of water quality, mechanism of water pollution, economic conditions, and social circumstances were settled and coordinated one by one in small steps. The current TPLCS was not established at the first stage. When the TPLCS is introduced for the first time, even if all issues cannot be addressed at once in implementing the TPLCS, it is important to accumulate knowledge and experience in implementing the TPLCS, introduce it wherever possible step by step, and arrange for various schemes and institutions.

2.1 Definition of pollutant discharge load

Next, the definition and concept of pollutant discharge load can be explained as follows.

After pollutant discharge load is generated in pollution sources, pollutant load is treated in the municipal wastewater treatment facility and discharged into water areas including rivers. In the process of flowing down the river, the pollutant discharge load is subject to natural purification and sedimentation and then flows into sea areas and lakes/ponds. Through these processes, pollutant discharge load is modified. Therefore, we should determine which stage each pollutant discharge load belongs to, and then proceed to the review work. The definitions of the terms are as follows.

Pollution source: generates pollutant load.

Quantity of pollutant load: the quantity of pollutant discharge load generated in each pollution source.

Discharge load: the pollutant discharge load discharged from pollution sources into water areas (rivers, sea areas, lakes/ponds).

The concept of “reaching ratio” is established to evaluate the purification of pollutants in the course of flowing down the river. Reaching ratio is the ratio of the pollutant discharge load which reaches a certain point in the downstream to the pollutant discharge load that was released into the river. The reaching ratio is determined based on the sections of a river in actual operation.

The figures below illustrate this process. Figure 2.1 shows a case where pollutant load is generated in a factory, discharged into the river after being purified at a municipal wastewater treatment facility, and then flows into an enclosed water area.

In this case, the factory is the pollution source.

The quantity of pollutant load is the quantity of the pollutant load generated in the process of production at the factory.

The discharge load is the pollutant discharge load discharged from the factory into the river. In this case, as the factory has a wastewater treatment facility and the pollutant load is removed there, the discharge load becomes smaller than the quantity of pollutant load. If the factory did not have a wastewater treatment facility and the pollutant load is discharged as it is, the quantity of pollutant load itself would be equal to the discharge load.

The discharged “discharge load” is purified while flowing down the river into the enclosed water area, and the ratio is expressed by the concept of “reaching ratio.”

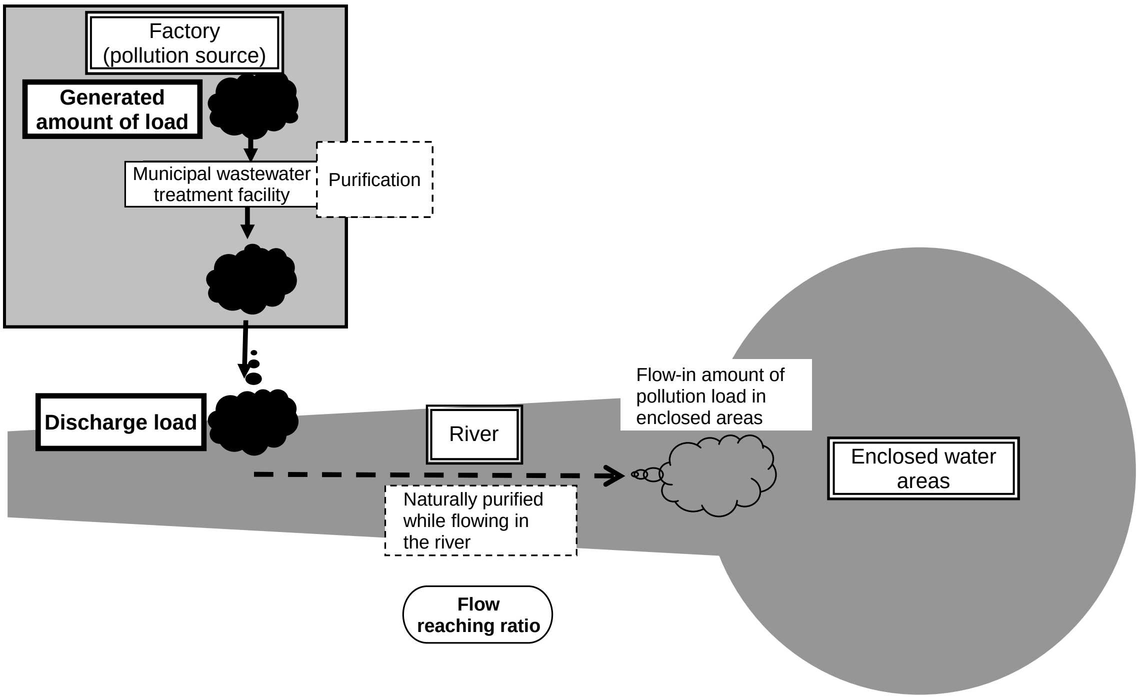


Figure 2.1　The flow of pollutant load and reaching ratio : an example of a factory

Pollution sources include factories and domestic effluents, livestock and farmlands, all of which are shown in Figure 2.2.

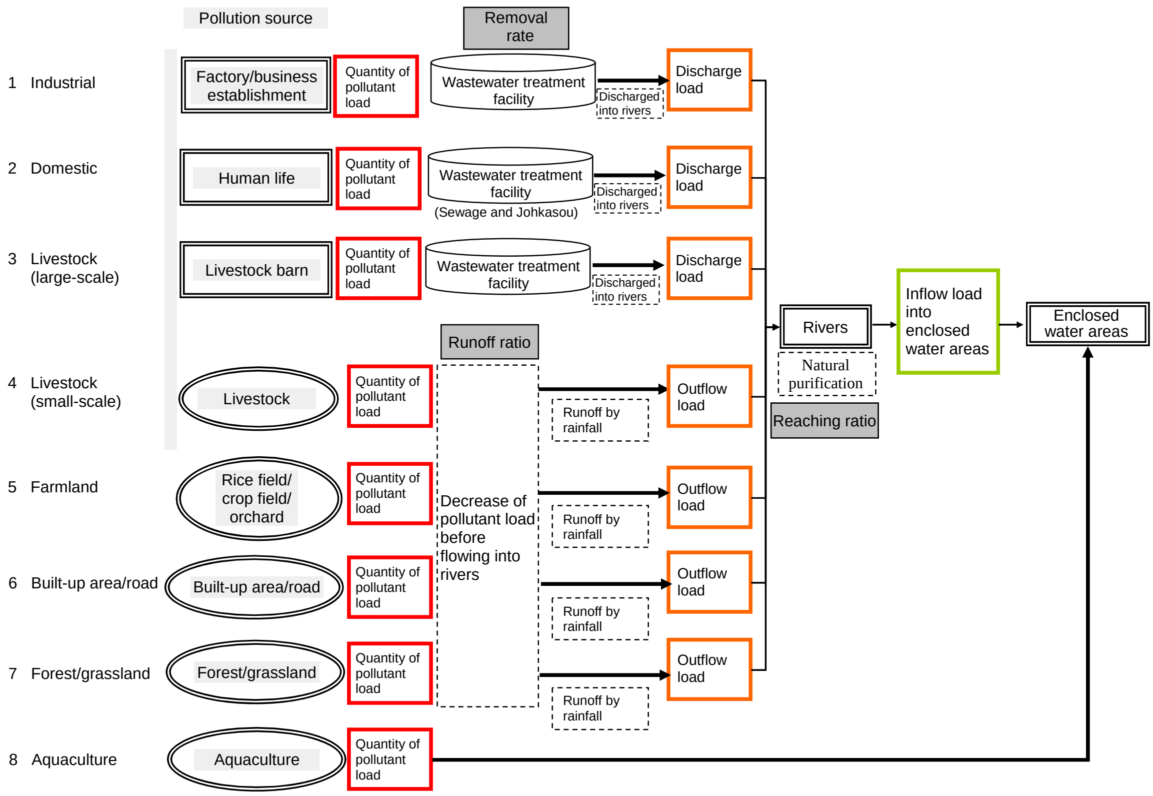


Figure 2.2 Flow of various sources and pollutant loads

In Figure 2.2, items 1 to 3 are point sources and items 4 to 8 are plane sources.

For livestock kept on a large scale, the livestock can be managed at each livestock barn. The livestock barn can be regarded as a pollution source. In contrast, in small-scale cases where a small number of livestock is kept at each farm, these are treated as plane sources because many livestock animals are kept on a plane. Often the difficulty is identifying each pollution source in practical terms. Meanwhile, item 8, aquaculture, is operated with preserves established within sea areas, so that the quantity of pollutant load is assumed to be mixed into the enclosed water area as it is. When aquaculture is operated apart from water areas, the pollutant discharge load contained in the effluent discharged from the breeding pond into the water area is regarded as its discharge load.

In Figure 2.2, the term “discharge load” is used for point sources 1 to 3, while the term “outflow load” is used for plane sources 4 to 8. “Outflow load” has the same meaning as “discharge load” in the sense that these are pollutant discharge loads flowing into rivers. The difference lies in the discharge method; while drainage will be constructed to discharge effluent directly for items 1 to 3, items 4 to 8 are often without drainage, and these let rainfall wash the effluent into rivers. In the text below, both of these are called “discharge load” if the above difference in strict meaning has no significance. Since pollutant load is subject to penetration into the soil and natural purification in the process from generation to discharge, the quantity of outflow load usually becomes smaller than the quantity of pollutant load. The ratio of the quantity of pollutant load to the outflow load is called the "runoff ratio."

The load quantity regulated under the TPLCS is discharge load.

2.2 Overview of the execution procedures

Figure 2.3 shows the implementation procedure of the TPLCS.

The overview of the implementation procedure begins by surveying the water quality of water areas and the status of pollution, assessing the status of pollution sources and the possibility of future modification at the sources due to economic growth, and judging if any total pollutant load control is required. Secondly, the water quality objective for the target water area should be established. Then the discharge load is calculated using the measured data required for the calculation of pollutant discharge load in the target area as well as the data on the industry and land use. After setting the target date for attaining the water quality objective, the management objective of the pollutant discharge load flowing into the water area should be established based on the water quality objective. The reduction quantity of the discharge load required to achieve the management objective should be calculated. The countermeasures to achieve the required reduction quantity by source should be reviewed, and the total reducible quantity should be aggregated. All this information should be collected and summarized in the "total pollutant load control plan," as the implementation plan. The measures should be implemented based on the total pollutant load control plan, and the plan should be revised as needed through monitoring the status of the pollutant discharge load reduction and water quality improvement.

Figure 2.3 shows 12 steps in sequence. However, these steps are not meant to be followed in the order shown, but should be employed as far as practicable, such as, for example, taking multiple steps at a time, as needed.

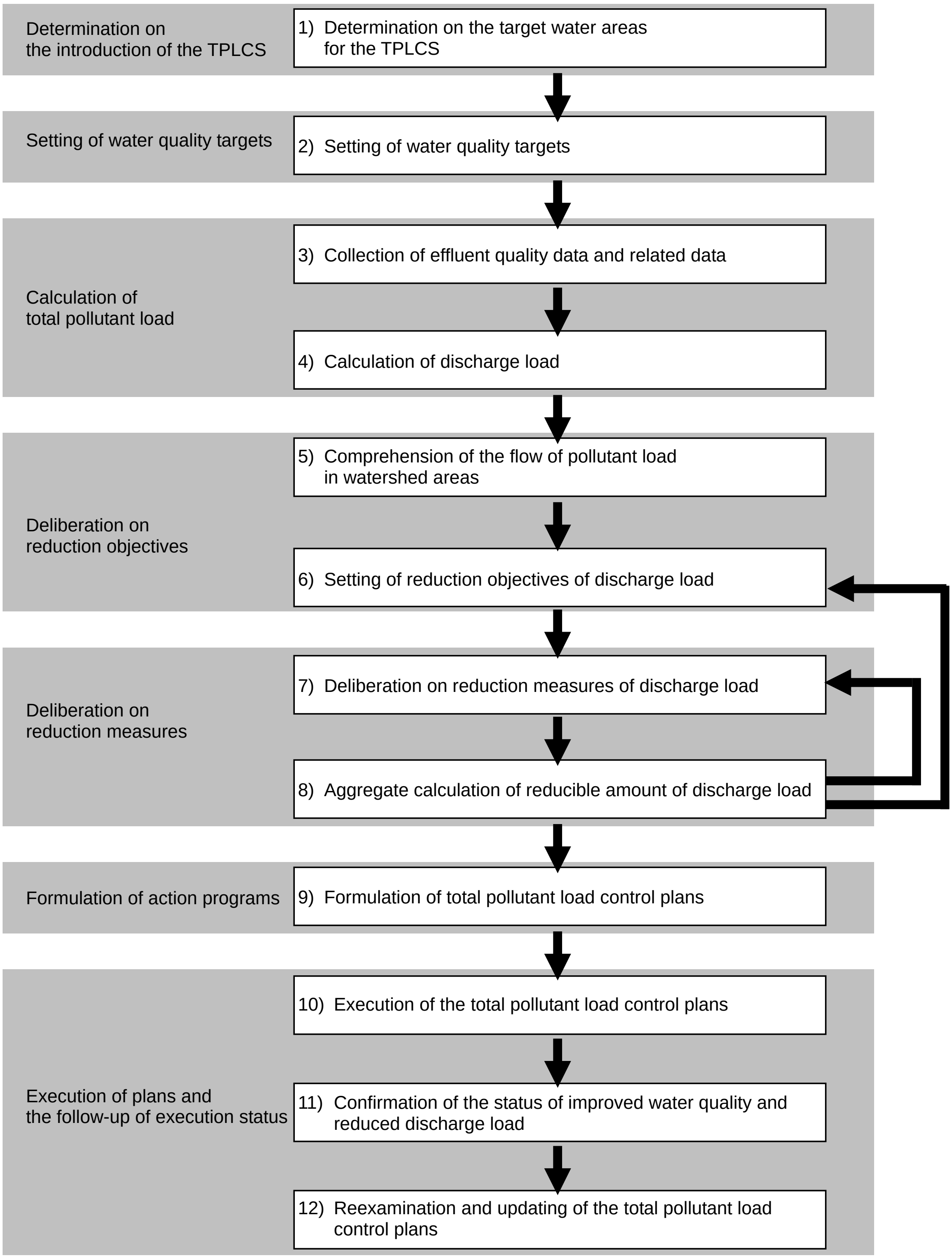


Figure 2.3 Processes of the TPLCS

2.3 The implementation procedures of the TPLCS

Here, the work methods will be described step by step at each stage of the implementation procedures for the TPLCS, based on the implementation method in Japan.

(1) Determination on the target water areas for the TPLCS

Determine the water area where the TPLCS is to be introduced.

Examples of the requirements for water areas where the TPLCS highly needs to be introduced are as shown in Table 2.1.

Table 2.1 Requirements for water areas where the TPLCS appreciably requires introduction

Requirements for water areas where the TPLCS appreciably requires introduction
i) A water area where serious water pollution has caused the degradation of living environment, destruction of the ecosystem, and difficulties in water utilization. ii) A water area where the aquatic environment decidedly needs to be preserved, and the concentration of population and construction of factories are predicted to degrade the water quality in the future. iii) The water area where measures taken, including effluent concentration regulation, have not yielded any benefits.

To determine if each water area meets these three requirements, the following information is needed.

i) The pollution status of water quality based on the measurement data of the water quality. A comparative assessment with the Environmental Quality Standards for Water Pollution.

ii) The purpose of water utilization and water utilization plans for the concerned water area.

iii) The status of difficulties in water utilization. Absence/existence, seriousness or future outlook of foul taste/odor of drinking water, fishery damage, degradation in value as a tourism resource, and degradation of ambient living environment.

iv) Future plans and outlook for population increase, construction of factories, industrial development.

v) The status of implementing effluent control and regulation. The effect of the regulation on preserving the water quality.

After the target water areas for the TPLCS has been determined, the TPLCS should be implemented in an area associated with the water quality of the water area. Such an area associated with the water quality of the water area is usually selected in a watershed area where the water flows in.

Column 2: Responses in cases where the TPLCS requires immediate introduction

In cases where water pollution is serious and the discharge load requires immediate reduction, or where the whole country has water pollution, the whole national land is specified as the target area.

Alternatively, in some countries it may be difficult to identify the watershed area which flows into the target water area due to the complexity of the flow paths of rivers or hydrological characteristics. In such cases, it may be possible to specify the administrative district in the watershed area as the target area for the TPLCS.

(2) Establishing water quality targets

Water quality targets are decided in accordance with the purpose of water utilization of the target water area. If the Environmental Quality Standards for Water Pollution have been established, the Environmental Quality Standards for Water Pollution should be the water quality target.

Column 3: Correspondence between the Environmental Quality Standards for Water Pollution (COD, total nitrogen and total phosphorus) and the purpose of water utilization in Japan

As described in section 1.2 (3), in Japan, the Environmental Quality Standards for Water Pollution for COD and BOD, which are the indicators of organic contamination, as well as for total nitrogen and total phosphorus, which are the indicators of eutrophication under the TPLCS are contained in Environmental water quality standard for protecting living environment, and the related environmental standards have been established for the categories created on the basis of the purpose of water utilization. The categories are created in accordance with the fitness for municipal water supply, industrial water supply, or agricultural water supply, and to the extent of purification treatment, types of aquatic resources, and the fitness for swimming. Tables 2.2 to 2.4 show the overview simplified to clarify the relations with the purpose of water utilization of the standards for COD, total nitrogen and total phosphorus, which are usually addressed under the TPLCS, among the Japanese Environmental Quality Standards for Water Pollution.

Table 2.2 The Environmental Quality Standards for Water Pollution in the sea areas of Japan (COD, total nitrogen and total phosphorus)

Category	Purpose of water utilization			Environmental standards
	Industrial	Aquatic resources	Others	COD
A	↑	Red sea bream, yellowtail, brown seaweed	Sightseeing, swimming	Not more than 2mg/l
B	↓	Striped mullet, laver		Not more than 3mg/l
C			No feeling of discomfort in everyday life	Not more than 8mg/l

Category	Purpose of water utilization			Environmental standards	
	Industrial	Aquatic resources	Others	total nitrogen	total phosphorus
I	↑	Various aquatic organisms including demersal fish and shellfish are captured in a balanced and stable manner.	Sightseeing, swimming	Not more than 0.2mg/l	Not more than 0.02 mg/l
II			Swimming	Not more than 0.3mg/l	Not more than 0.03 mg/
III		Except for some demersal fish and shellfish, aquatic organisms are captured consisting mainly of fish.		Not more than 0.6 mg/l	Not more than 0.05 mg/l
IV	↓	Mainly specific pollution-resistant aquatic organisms are captured.	Habitat boundary of demersal organisms can live through the year	Not more than 1mg/l	Not more than 0.09 mg/l

* The categories of water area in relation to total nitrogen and total phosphorus are specified for those sea areas where marine phytoplankton are likely to increase significantly, such as enclosed seas.

* Daily average values for COD and annual average values for total nitrogen and total phosphorus

Table 2.3 The Environmental Quality Standards for Water Pollution in the lakes/ponds of Japan (COD, total nitrogen and total phosphorus)

Category	Purpose of water utilization					Environmental standards
	Municipal water	Industrial water	Agricultural water	Aquatic resources	Others	COD
AA	Simple operations including filtration	Regular operations including sedimentation		Kokanee salmon	Sightseeing, swimming	Not more than 1mg/l
A	Regular operations including sedimentation and filtration, advanced operations			Salmon, sweetfish	Swimming	Not more than 3mg/l
B				Carp, crucian carp		Not more than 5mg/l
C		Advanced operations including chemical injection			No feeling of discomfort in everyday life	Not more than 8mg/l

Category	Purpose of water utilization					Environmental standards	
	Municipal water	Industrial water	Agricultural water	Aquatic resources	Others	total nitrogen	total phosphorus
I	Simple operations, regular operations, advanced operations			Salmon, sweetfish	Sightseeing, swimming	Not more than 0.1mg/l	Not more than 0.005 mg/l
II					Swimming	Not more than 0.2mg/l	Not more than 0.01 mg/l
III	Special operations			Lake smelt		Not more than 0.4mg/l	Not more than 0.03 mg/l
IV						Not more than 0.6 mg/l	Not more than 0.05 mg/l
V				Carp, crucian carp	No feeling of discomfort in everyday life	Not more than 1mg/l	Not more than 0.1 mg/l

* The categories of water area in relation to total nitrogen and total phosphorus are specified for those sea areas where lake/pond phytoplankton are likely to significantly increase. The standards for total nitrogen are applied to lakes and ponds where total nitrogen causes the lake/pond phytoplankton to

increase significantly.

* Daily average values for COD and annual average values for total nitrogen and total phosphorus

Table 2.4 The Environmental Quality Standards for Water Pollution in the rivers of Japan (BOD)

Category	Purpose of water utilization					Environmental standards
	Municipal water	Industrial water	Agricultural water	Aquatic resources	Others	BOD
AA	Simple operations including filtration			Landlocked salmon, mountain trout	Sightseeing, swimming	Not more than 1mg/l
A	Regular operations including sedimentation/filtration	Regular operations including sedimentation			Swimming	Not more than 2mg/l
B	Advanced operations			Carp, crucian carp		Not more than 3mg/l
C				Carp, crucian carp		Not more than 5mg/l
D		Advanced operations including chemical injection				Not more than 8mg/l
E		Special operation			No feeling of discomfort in everyday life	Not more than 10mg/l

* Daily average values for BOD

(3) Collection of effluent quality data and related data

The TPLCS is a quantitative system, and as it should be employed on the basis of scientific evidence as much as possible, related data need to be collected. These data can be classified into the two main categories of data related to aquatic environment and those related to sources, which categories are used in the description below. There may be cases where only a few data can be collected at an early stage, but it is important to adjust the framework for collecting data and to increase the precision little by little in the process of implementing the TPLCS.

i) Collection of the data related to aquatic environment

To quantitatively assess the status of water pollution in water areas and to analyze the relationship among the flow paths of pollutants, the inflow load flowing in the water areas and the water quality of the target water areas, the data on the quality and quantity of the target water areas and related rivers or lakes/ponds should be collected. As existing materials alone may not provide adequate data, as much as possible the water quality should be measured to acquire adequate data, and calculations should be conducted with as the collected data.

For the analysis on the aquatic environment of the water area, in addition to the water quality data, the following data should be collected and consulted in the analysis.

- Topographic maps of the surrounding areas.
- Climate condition (precipitation, amount of solar radiation, temperature, wind direction, wind velocity, humidity).
- Maps of drainage system, dams and weirs, location of major water intakes. Status of water channels and sewage drains.
- Present status and future trends of water utilization (drinking water, industrial water, agricultural water).
- Water depth, topographical features, tide level, tidal currents, water temperature, salinity.
- Status of ecosystem including animals and plants.

ii) Collection of data related to the sources of pollution load

Under the TPLCS, it is important to calculate the discharge load based on accurate data as much as possible. Therefore, the data on the sources of pollutant loads should be collected.

However, as existing materials alone may not provide a wide range of data, data should be acquired by measuring the water quality of effluents as far as possible, and the discharge load should be calculated with as much collected data to obtain the most accurate actual conditions as possible in the given situation. There may be cases where only a few data can be collected at an early stage, but it is important to adjust the framework for collecting data and to little by little increase the precision in the process of implementing the TPLCS. Table 2.5 summarizes the data to be collected.

Table 2.5 Data to be collected to calculate the discharge load

<table>
<tr><th colspan="2">Sources of pollutant load</th><th colspan="2">Data to be collected</th></tr>
<tr><td colspan="2">i) Industrial</td><td>• Concentration and quantity of effluents from factories and business establishments</td><td>When the data shown in the column at the left are absent, survey the following items and conduct estimated calculations.
• Quantity of industrial water consumed
• Types, production amounts and shipment value of products
• Number of employees
• Types and used amount of raw materials
• Production processes
• Others, sector-specific data
• Absence/existence of municipal wastewater treatment facility. If installed, the types, capacity and its utilization.</td></tr>
<tr><td colspan="2">ii) Domestic</td><td colspan="2">• Resident population
• Dissemination status of domestic effluent treatment facilities (connection to sewage systems, population using the treatment method with Johkasou, and the population involved if night soil is collected and treated)
• Number of tourists</td></tr>
<tr><td></td><td>Final sewage treatment systems</td><td colspan="2">• Population addressed by treatment plants
• Concentration and discharge quantity of treated effluents
• Methods for sludge treatment</td></tr>
<tr><td></td><td>Johkasou</td><td>• Population addressed by treatment
• Concentration and discharge quantity of treated effluents
• Methods of treating wastewater</td><td>When the data shown in the column at the left are absent, survey the following items and conduct estimated calculations.
• Methods of treating wastewater
• Scale of Johkasou (number of people addressed)</td></tr>
<tr><td>iii) Livestock</td><td>Large-scale barns</td><td>• Concentration and discharge quantity from livestock barns</td><td>When the data shown in the column at the left are absent, survey the following items and conduct estimated calculations.
• Livestock species
• Number of livestock kept
• Absence/existence of municipal wastewater treatment facility. If installed, the types, capacity and utilization.</td></tr>
<tr><td></td><td>Small-scale barns</td><td colspan="2">As these are regarded as plane sources and it is difficult to measure at the pollution source, survey the following items to conduct estimated calculations.
• Species and number of livestock kept in each locality</td></tr>
<tr><td colspan="2">iv) Farmland</td><td colspan="2">As these are regarded as plane sources and it is difficult to measure at the pollution source, survey the following items to conduct estimated calculations.</td></tr>
</table>

	• Square measure of the farmland (square measures by type, such as rice field, crop field, or orchard.) • Quantity of fertilizers applied
v) Built-up area	As these are regarded as plane sources and it is difficult to measure at the pollution source, survey the following items to conduct estimated calculations. • Square measure of the built-up area
vi) Forests	As these are regarded as plane sources and it is difficult to measure at the pollution source, survey the following items to conduct estimated calculations. • Square measure of the forest and grassland
vii) Aquaculture	As these are regarded as plane sources and it is difficult to measure at the pollution source, survey the following items to conduct estimated calculations. • Species, number and shipped quantity of aquacultured fish including shrimp/prawns. • Feeding volume

(4) Calculation of discharge load

Calculate the pollutant load for each pollution source: industry, domestic, livestock, farmland, built-up area, forest, and aquaculture.

The pollutant load of any pollution source is to be measured, in principle, and is estimated from the quality or quantity of effluents. If the related data are absent, the pollutant discharge load per unit, such as the number of livestock or the square measure of farmland, as the basic unit, should be established, and estimation calculations (called the “ratio method”) should be calculated.

In areas of Japan where the TPLCS is implemented, as the factories and business establishments with effluent quantity not less than $50m^3$/day are addressed under the Total Pollutant Load Control standards, those factories and business establishments are required to measure the quality and quantity of effluents. For small business establishments with effluent quantity below $50m^3$/day as well as the business sectors unaddressed, because the business entities are not required to measure the related data and consequently no data is available, these are calculated using the ratio method. For the domestic sector, discharge load must be measured at sewage treatment plants, large-scale Johkasous and night soil treatment plants. Since small-scale Johkasous are not required to measure these data and no data is available, the discharge load is also calculated using the ratio method.

For livestock, as large-scale livestock barns are addressed under the Total Pollutant Load Control standards, the discharge load must be measured. Since these data do not have to be measured at small-scale livestock barns and no data is available, the discharge load is calculated using the ratio method (see Table 2.6).

The details of calculation are described in Reference Material 2.

Column 4: Examples of responses when the actual measurement values declared by factories and business establishments lack credibility

If the actual measurement data are based on the declaration by factories and business establishments, and if the data lack credibility because the administrative supervisory management is not adequate, it is important from the viewpoint of calculating as precisely as possible that data estimation be carried out using the ratio method to confirm the credibility of the actual measurement data, which calculation method is found in actual cases. In this case, the factories and business establishments, whose actual measurement data greatly differ from the values calculated with the ratio method, should be carefully examined, and remeasurement is to be performed on a case-by-case basis.

Table 2.6 Calculation methods of pollutant discharge load by source in Japan

					Actually measured at business establishments	The ratio method
Industrial	Factory/business establishment	Target of total pollutant load control	With effluent quantity not less than $50m^3$/day		○	
		Non-target of total pollutant load control	With effluent quantity less than $50m^3$/day			○
			Non-target business sector			○
	Wastewater treatment facility for industrial effluents				○	
Domestic	Sewage plants				○	
	Johkasou	Treats the effluents generated by factories/business establishments, and offices	Johkasou for more than 501 persons		○	
			Johkasou for more than 201 persons	With effluent quantity not less than $50m^3$/day	○	
				With effluent quantity less than $50m^3$/day		○
			Johkasou for not more than 200 persons			○
		Treats the domestic effluents generated by residences	Johkasou for more than 501 persons		○	
			Johkasou for more than 201 persons	With effluent quantity not less than $50m^3$/day	○	
				With effluent quantity less than $50m^3$/day		○
			Johkasou for not more than 200 persons			○
	Night soil treatment plants (facilities which collect and centrally processes night soil from dip-up toilets)				○	
	Untreated domestic wastewater					○
Livestock	Target livestock barns addressed by total pollutant load control		Cattle	With effluent quantity not less than $50m^3$/day and the square measure of a cowbarn not less than $200m^2$	○	
			Horses	With effluent quantity not less than $50m^3$/day and the square measure of a horsebarn not less than $500m^2$	○	
			Hogs	With effluent quantity not less than $50m^3$/day and the square measure of a hogbarn not less than $50m^2$	○	
	Non-target of total pollutant load control					○
	Wastewater treatment plants for livestock effluents				○	
Farmland	Rice field					○
	Crop field/orchard					○
Other lands	Forest					○
	Other lands					○
Aquaculture	Sea surface					○
	Freshwater surface					○

(5) Comprehension of the flow of pollutant load in watershed areas

Discharge load is naturally purified in the course of running down water channels and rivers until it flows into water areas, and the load quantity also changes through self-purification in sea areas and lakes/ponds. Therefore, this section analyzes how the pollutant discharge load changes while it flows along by exploring its flow paths and the mechanism of variation, purification and accumulation. The mechanism of the change of pollutant load in these water areas is complicated and precise analysis is difficult, but the following steps are employed in practical terms.

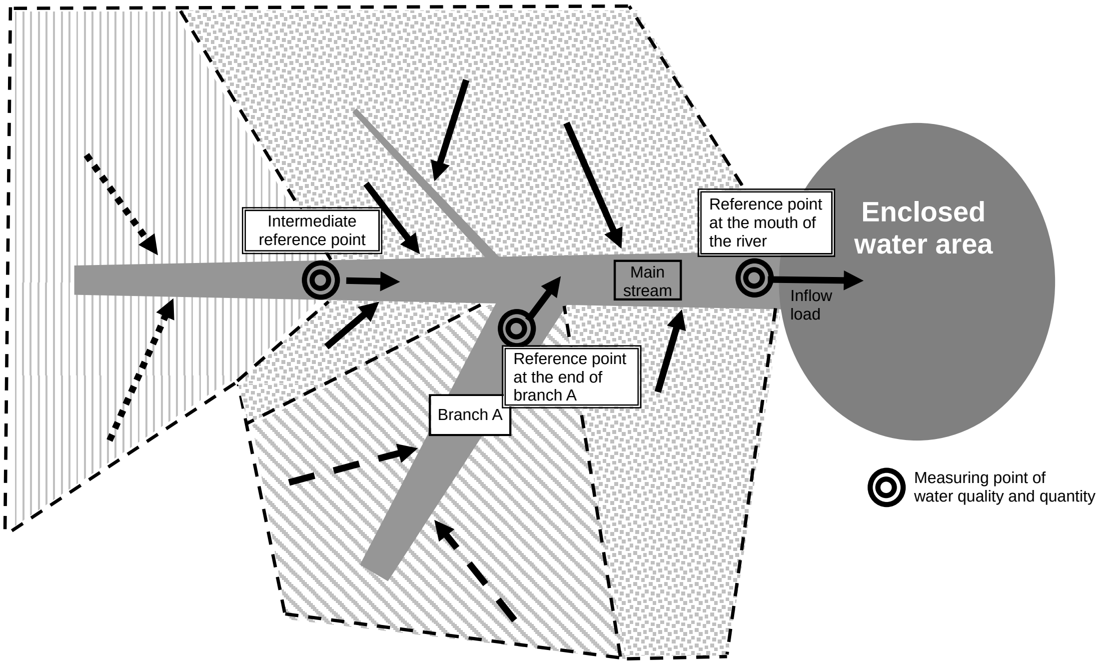
i) Understanding catchments and river systems

Create a watershed area map for each area referring to the maps of water systems, and understand how the effluent from the pollution source follows the paths to reach lakes/ponds and sea areas.

ii) Calculating reaching ratio

Discharge load is naturally purified in the course of flowing into water areas. In order to assess the purification capacity, reaching ratio is to be calculated.

The concept of reaching ratio is described in section 2.1. Reaching ratio is a ratio of discharge load to inflow load. In this section, the calculation result in section 2.3 (4) is used for the discharge load, and the inflow load is calculated from the flow volume of rivers with the actually measured water quality data. Reaching ratio is calculated by sectionalizing the rivers into several parts when the length of the river is long or if the conditions of the banks and bottoms of the river significantly change. If the river system has important water utilization points such as water intakes, the points may be the breakpoints. For large tributaries, other points may be used as the breakpoints. These examples are shown in Figure 2.4, and in all these cases the water systems need to be known.



In this example, the measuring point was set at the mouth of the main stream, and the water quality and quantity were measured. Other than these, measurements were also taken at the intermediate reference point between the end of branch A (at the confluence with the main stream) and the main stream. In this case, the reaching ratio upstream of the intermediate reference point is calculated from the sum of the discharge load (arrowed dashed line) upstream of the intermediate reference point and the pollutant discharge load at the intermediate reference point. Similarly, the reaching ratio of branch A is calculated. For the main stream downstream of the intermediate reference point, the reaching ratio can be calculated by finding the sum of the discharge load released at the point (arrowed solid line), the pollutant discharge load (measured at the intermediate reference point) flowing from the intermediate reference point and the pollutant discharge load (measured at the end of branch A) flowing from branch A, and finding the ratio to the pollutant discharge load at the mouth of the river.

Figure 2.4　A pattern diagram of watershed area and measuring points

iii) Analysis on the variation of pollutant discharge load within an enclosed water area

To clarify the relationship between the inflow load flowing in the enclosed water area of the sea area or the lake/pond and the water quality of the enclosed water area, the next step is to analyze the conditions for the factors of variation generated in the sea area or the lake/pond using a model as shown in Figure 2.5.

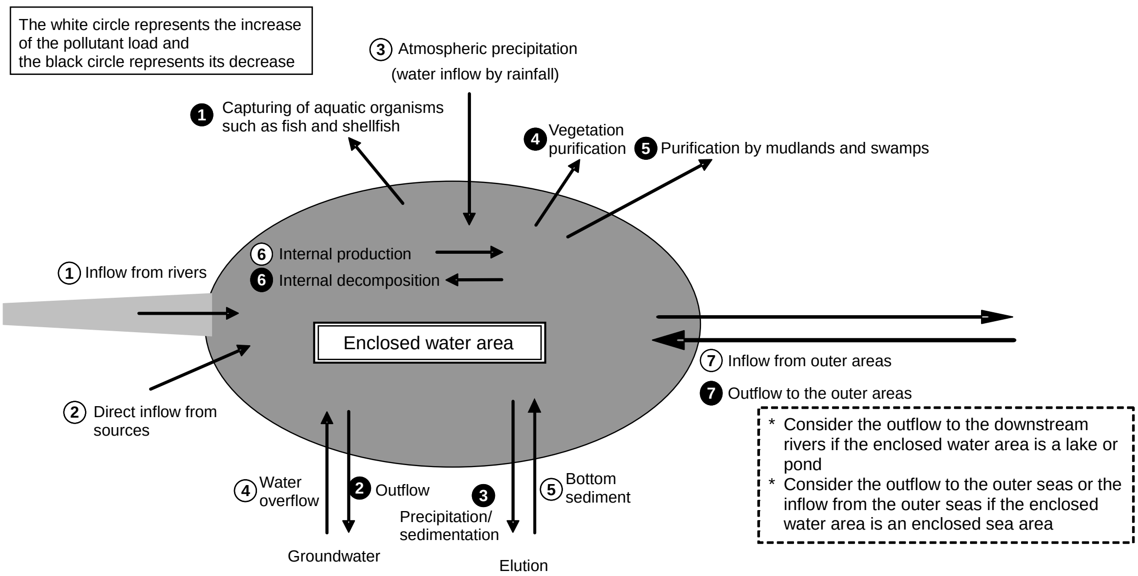


Figure 2.5 Major factors for variation in the pollutant load within the enclosed water area

The modeling can be done in the following two ways:

a) A method for modeling the causal association in the mechanism which causes the variation of pollutant loads as truly as possible, and formulates an analytical formula which expresses the phenomenon by combining these models.
b) A method for statistically finding the correspondence between the input and output of pollutant discharge load. For instance, this method finds the correspondence from the statistics of the sum of inflow load and the outflow load from enclosed water area.

In method a), as the number of formulas and coefficients used in the model increases in accordance with the complexity of the related data, the need becomes conducting surveys for giving accurate data and verifying the model. Since the phenomena taking place in sea areas and lakes/ponds are complicated and detailed modeling is difficult, it is important to pursue the analysis to the extent possible, paying attention to the water quality of the concerned water areas. In general, the aim is to first apply simple models, and then step by step to consider more complicated models, as needed. In recent years, owing to the progress of computer simulation technologies, computer simulation is sometimes employed, and this is also utilized as reference material in Japan.

At the time of introduction, the need is to understand the current status to the extent possible first considering the available range of data, and to proceed to the next analysis. The requirement is an attitude to accumulate the data on water quality of the water area while implementing the total pollutant load control, and gradually deepen understanding of the water area.

It depends on the extent to which how truly the model created above reflects the phenomena, but, generally, a) will become a comparatively complicated method. Although b) is a comparatively simple method, but as it seeks to infer the correlation setting aside the understanding of the mechanism within the water area, it is desirable to adopt method a) as much as possible.

(6) Establishing reduction objectives of discharge load

The total reduction objective of discharge load and the target date for attaining the objective should be established.

The target date for attaining the objective should be determined based on the period of time needed to implement the reduction measures and the urgency of improving the water quality of the water area concerned. As the reduction objective and prerequisites for the total pollutant load control plan will change in accordance with significant changes in external conditions, such as technological development and socio-economic circumstances, establishing the target date too far off in the future should be avoided. Generally, three to five years into the future will be considered adequate. In Japan, target dates are established every five years and China establishes the total pollutant load control objectives in accordance with the Five-Year Plan. Alternatively, intermediate objectives may be set at the specified intermediate times for the purpose of ensuring attainment of the objective.

For how to establish a reduction objective, the required reduction amount should be established as the reduction objective for attaining the water quality objective based on a top-down approach. If the reduction objective is difficult to meet due to the current conditions of technology, economy, and finance, a good approach is to establish another feasible objective considering the conditions at the time, and raise the reduction benchmark in incremental steps toward the improvement target of the water quality.

To establish the objective for attaining the improvement objective of the water quality based on a top-down approach, the next step is to calculate an allowable inflow load from the final water quality objective using the reaching ratio and the analysis on the variation of pollutant discharge load within an enclosed water area calculated in section (5) above, and establish this load as the reduction objective.

Before establishing the reduction objective, a forecast on the increase of pollutant discharge load by the target date should be made. In countries where industry and economy are developed, as construction of new factories and population increase are expected, the need is to consider the required reduction amounts of existing pollution sources by incrementing the pollutant discharge load due to the occurrence of new pollution sources.

Feasible objectives should be established by aggregating the performance in wastewater treatment at factories and business establishments, technologically reducible amount by advanced treatment and reducible amount by construction plans for new sewage systems.

(7) Deliberation on the reduction measures of discharge load

Reduction measures should be considered for each type of source.

i) Measures for industrial sources

The TPLCS regulates the total amount of discharge load.

Factories and business establishments seek to reduce discharge load by installing and reinforcing municipal wastewater treatment facility and by changing production processes and raw materials to meet the Total Pollutant Load Control standards. To ensure that factories and business establishments implement these measures, administrative bodies need to provide specific technical instructions and to impose administrative and judicial punishment if the standards are not met.

Additionally, when the total pollutant load control is applied to the discharge load, parallel efforts will be needed to ensure compliance with the regulatory standards for the specified discharge load. In addition to the technical instructions and supervisory management by the administrative bodies described, possible measures include supplementary supports such as low-interest financing loans for funding the installation of municipal wastewater treatment facility and social inhibition on businesses. Various measures may be employed to ensure that factories and business establishments comply with standards. It is important to combine these measures in accordance with each national condition and to pursue a comprehensive development strategy. Sections 3.3 and 3.4 describe the means for the purpose including actual cases in Japan.

Japan's "Total Pollutant Load Control Standard" is shown in Reference Material 3.

ii) Measures for domestic sources

As measures for domestic sources, domestic effluent treatment by means of constructing sewage systems and advancing effluent treatment systems should be pursued.

Sewage systems are constructed especially in densely-populated urban areas. In farm villages and residential estates where people live collectively, constructing small-scale sewage systems and treating the wastewater by centralized treatment should be the approach. If the residences are far from one another, installing respective Johkasous is the solution.

Promotion of domestic effluent treatment needs to be pursued in accordance with the plan. In Japan, the five-year plan for sewage improvement project was initiated for sewage systems in 1963. In local municipalities, depending on the distribution of residences, sewage systems should be utilized in large areas, small-scale sewage systems and respective Johkasous selectively, and plans have been developed for treating domestic effluents. Sewage systems collect wastewater through conduits and provide efficient centralized treatment, but they are not economical in thinly-populated regions because the installation distance of conduits tends to be longer in those regions. Therefore, it is efficient to adopt a domestic effluent treatment method suitable for each regional condition, and each region has selected an efficient treatment method, considering its population, population density and distribution of residences. Formulation of plans for treating domestic effluent is described in section 3.5.

The sludge generated in sewage plants and Johkasous requires treatment. If the sludge is left without treatment, it may flow into water areas during rainfall, and may cause secondary pollution. Treatment methods of sludge include dehydration/incineration and composting. The current status of Japan's sludge treatment is described in Reference Material 5.

The reduction amount of domestic discharge load is calculated on the basis of plans for disseminating sewage systems/Johkasous and plans for enhancing wastewater treatment, considering the change in the population addressed by sewage systems/Johkasous or in the treatment ratio at wastewater treatment facilities.

iii) Measures for livestock sources

It is important that measures for livestock seek to optimize the storage of livestock night soil, which is the main source.

Large livestock barns should be addressed by total pollutant load control and effluent control. For small livestock barns, considering their tendency towards centralization and expansion in scale along with economic and social development, they should be instructed to install purification facilities as individual measures.

iv) Measures for farmland sources

Measures for farmlands should seek to reduce the inflow nutrients, which are compounds of nitrogen and phosphorus, through an appropriate application of fertilizer. However, since the application amount has a considerable influence on the yield of agricultural products, it is necessary to examine an adequate amount at which the reduction effect and the yield are both favorable.

The recommendation for rice fields is to adopt "circulatory irrigation," where the effluents from rice fields with high pollutant load content are circulated and reused.

v) Measures for built-up areas

The load from pollution sources flows into water areas with the rainfall. Therefore, related measures include preventing the pollutants accumulated on the ground or the roofs of buildings from flowing out, eliminating them, and controlling effluents.

To prevent the accumulated pollutants from flowing out and to eliminate them, it is possible to prohibit the dumping of waste, collect and treat the waste, and clean the road surface and side ditches.

For the control of effluents, construction of rainwater infiltrating facilities such as a rainwater infiltrating box and infiltrating drains, or rainwater storing/treatment facilities is possible.

vi) Measures for forests

These measures include the improvement of forest management, erosion and sediment control, and prevention of illegal dumping of waste and trash.

(8) Aggregate calculation of reducible amount

The reduction amount of discharge load by the reduction measures described in section (7) should be aggregated. Then the aggregate value should be compared with the reduction objective of the total pollutant load. Whether the value meets the reduction objective should be examined.

If the aggregate value meets the reduction objective, the next step is to determine whether to adopt the respective measure or the priority of implementation, judging from the implementation period, ease of the implementation, and the costs of each measure.

If the reduction objective is not met, the need is to review the reduction measures and add further reduction measures. If the revised measures still fall short of the reduction objective, a further review should be provided on the reduction objective from the standpoint of formulating a feasible plan.

(9) Formulation of total pollutant load control plans

As a result of the above reviews, a quantitative assessment of the current status of discharge load, reduction objectives (target date and the total discharge load on the date), and reduction measures will be provided. These pieces of information should be organized and a total pollutant load control plan should be formulated. As the total pollutant load control plan will be shared with the administrative offices and local administrative bodies concerned, this needs to be authorized through the procedures within the administrative sectors.

In Japan, the Minister of the Environment formulates the TPLCS policy, on the basis of which the Prefectural Governors are supposed to formulate the total pollutant load control plan. In this case, procedures are provided for hearing the positions of the Minister of the Environment, the Ministries and the local administrative bodies. Figure 2.6 below shows the procedures.

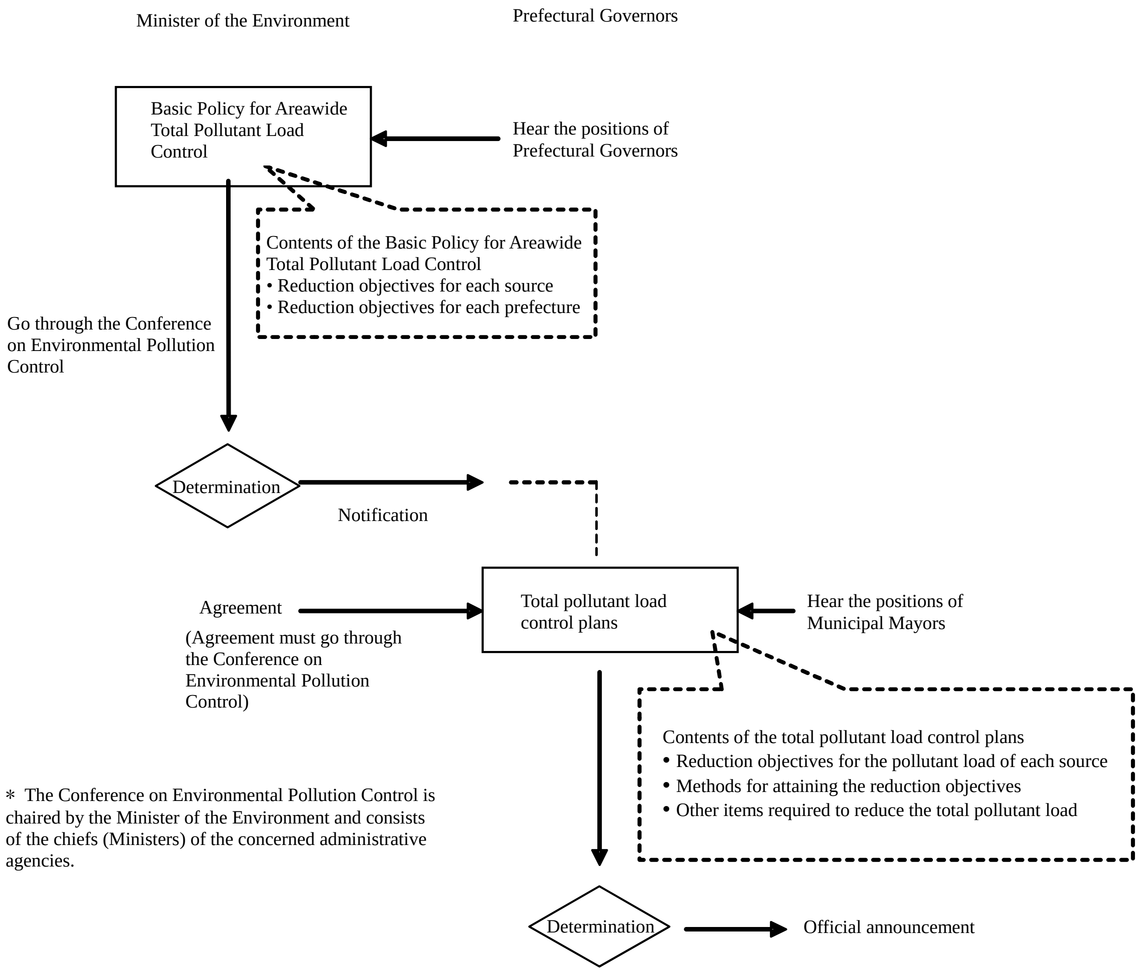


Figure 2.6 The procedure for formulating the total pollutant load control plans in Japan

The total pollutant load control plan should incorporate related matters in addition to reduction measures, such as the actual measurement of the water quality of water areas, supervisory monitoring of factory effluents, supportive measures for installing wastewater treatment facilities at factories, and preparation of the framework for promoting the reduction of pollutant load. Table 2.7 shows a typical example of a total pollutant load control plan in Japan.

Table 2.7 Typical example of a total pollutant load control plan in Japan

A plan for reducing the total Chemical Oxygen Demand, Nitrogen, and Phosphorus
1. Reduction objective (Target amount for the target fiscal year)
(1) Chemical oxygen demand
(2) Nitrogen content
(3) Phosphorus content
2. Methods for attaining the reduction objectives
2.1. Measures for domestic wastewater
(1) Construction of sewage systems
(2) Construction of other domestic effluent treatment facilities
(3) Measures for the domestic effluent from general households
2.2 Measures for industrial effluent
(1) Establishing the Total Pollutant Load Control standard
(2) Measures not applicable to business establishments under the Total Pollutant Load Control standard
2.3. Other measures on pollutant sources
(1) Measures for reducing the pollutant load from farmlands
(2) Measures for livestock effluents
(3) Improvement of aquafarms
3. Other items required to reduce the total pollutant load
(1) Reconstruction of sound water circulation
(2) Promotion of water purification projects
(a) Promotion of water purification projects for rivers and water channels
(b) Promotion of bottom sediment improvement projects
(3) Preservation and regeneration of rivers, seashores, and tidal flats
(4) Establishment of monitoring system
(5) Environmental learning, education, awareness-raising activities
(a) Environmental learning and education
(b) Awareness-raising activities
(6) Establishment of a research system
(7) Assistance measures for small and mid-sized businesses

(10) Execution of total pollutant load control plans

The total pollutant load control for discharge load from factories and business establishments is implemented as a main measure of the TPLCS. It is also implemented for point sources such as hospitals, accommodation facilities, large-scale restaurants, large-scale kitchens for making packed lunches and prepared foods, automobile repair shops, cleaning facilities for laundry industries, large livestock barns, sewage plants, large Johkasous, and night soil treatment facilities, among others. Activities including technical instructions for pollutant reduction should be conducted along with the related regulations. Measures for the construction of sewage systems, appropriate storage of livestock night soils, and promotion of treatment should be pursued in accordance with the total pollutant load control plans.

In implementing such total pollutant reduction measures, establishment of various related frameworks and systems and coordination and cooperation relationships with the administrative sectors described in section 1.5 are required. The total pollutant load control is to be implemented under such systems and frameworks.

(11) Confirmation of the status of improved water quality and reduced discharge load

The total amount of discharge load should be calculated on the target date and the determination of the attainment of the total pollutant reduction objective and the extent. Additionally, improvement in the status of the water quality of the target water area should be confirmed, and the effect of total pollutant load control should be examined and reported.

(12) Reexamination and updating of total pollutant load control plans for their development

On the basis of section (11), the results and accomplishments of the total pollutant load control plan should be summarized, the future direction of the TPLCS should be discussed, the total pollutant load control plan should be reviewed, and a new plan should be explored.

In the review and exploration of plans, the following points need to be considered.

a. Confirm the extent of attaining the reduction objective

Unless the objective is met, the reason and measures to respond to the status should be explored and reflected in the next plan.

b. Confirm the changing state of water quality

How the water quality was influenced as a result of reducing the pollutant discharge load flowing into the water areas should be confirmed. If the water quality still does not meet the target quality, the TPLCS needs to be enhanced. In the water areas where water pollution has become exacerbated, to some extent the total pollutant load control may not improve the water quality. These cases are often found in Japan, and the reason is that the amount of pollutant discharge load already accumulated in the water areas and the bottom sediment is so significant that limiting the inflow volume alone does not lead to the reduction of the pollutant discharge load in the water areas. Even in these cases, the water quality will show signs of improvement over time by a consistent continuation of the TPLCS. It is important to firmly maintain the TPLCS.

c. Take into account the status of the implementation framework and related systems

By making use of the achievements obtained in the course of implementing the TPLCS, more effective efforts can be made under the next total pollutant load control plan.

Even if many outstanding issues may be left at the end of the first stage of introduction, the issues are to be settled in the course of implementing the TPLCS. For example, the more actual measurement data are obtained, the more scientific reduction objective amount and management objectives can be established. Also the sources that were not targeted at the introduction stage of the TPLCS can be addressed under the TPLCS by collecting related statistical data. If the research on the pollution mechanism of water areas shows progress and greater understanding of the mechanism, the total pollutant load control plan can be reviewed based on more scientific grounds. In this way, it is important to seek to fulfill the TPLCS by making use of the experience and achievements in implementing the total pollutant load control.

2.4 Introduction of the system well-adapted to local needs and situation

The implementation procedures and the contents of the TPLCS were described in section 2.3, based on the methods adopted in Japan. When actually implementing the TPLCS, it is important to allow the TPLCS to respond to the status of the targeted water areas and the purpose of introduction, and to make it appropriate for the situation in each country and region. In addition, when introducing the TPLCS for the first time, it is often difficult to completely implement the whole TPLCS. Therefore it is necessary to look at how to introduce the TPLCS, considering the situation and needs of the concerned region.

Section 2.4 illustrates how to introduce the TPLCS and matters to be addressed when introducing the TPLCS using examples. One example assumes the water pollution of the water area is worsening and the discharge load must be reduced at once. Another example assumes that there are concerns about the possibility of water pollution due to population growth and industrial development. Both examples may provide help in how to introduce the TPLCS in a manner appropriate to the local needs and situation.

(1) Example 1: the water pollution of the water area is worsening and the discharge load must be reduced at once

If the water quality of a water area is in a serious situation and is threatening to worsen, the discharge load needs to be reduced immediately. In such a case, it is important to take surefire measures, paying attention to the source that has a significant influence on the water quality of the water area. When introducing the TPLCS in such a case, the following points should be the focus in coping with the situation.

i) When calculating the discharge load, the precedence is to identify the source that has a significant influence on the water quality.

ii) When analyzing the flow of pollutant load in the watershed area, a simple method should be employed.

iii) When establishing an initial reduction objective, as much as possible a comprehensive objective should be established.

iv) For factories and business establishments, the total amount of pollutant discharge load should be regulated. A Total Pollutant Load Control standard should be established that can reduce the total amount in a reliable manner, considering the increase in pollutant discharge load due to newly constructed factories. When the proportion of domestic sources is large, measures that can be immediately implemented should take precedence. If untreated night soil flows in the water area, a low-cost surefire method should be introduced, such as dipping up night soil, on a preferential basis and at the same time, centralized treatment should be applied.

v) Improvement of the water quality may not be clearly shown immediately if the water pollution is serious, but the operator should persistently keep on the TPLCS, watching the changing situation of the aquatic environment of the water area.

(2) Example 2: Concerns about the possibility of water pollution due to population growth and industrial development

When industrial development and population growth are foreseen due to the development of the watershed area, preventive pollutant load management is required. When it is important to preserve the water quality because the water area is utilized as a source for drinking water, special measures are required. In such a case, it is important to adequately manage the discharge load on the basis of the aquatic environment of the water area and the sources of the inflow pollutant load, considering the pollutant discharge load that is predicted to increase in the future.

When introducing the TPLCS in these cases, it seems important to take measures focusing on the following points.

i) The water quality target should be established in consideration of the purpose of water utilization in the water area.

ii) An accurate assessment on the current status of the water area should be made by measuring the water quality. When estimating the discharge load, as much data as possible should be collected and accurately calculated.

iii) When establishing the management objective for the pollutant discharge load that flows into the water area, the management objective should be established at the level required to attain the water quality objective.

iv) Based on a projection on the factors contributing to the increase of pollutant discharge load, such as industrial development and population growth, reduction measures for containing the pollutant load should be implemented within the environmental capacity of the water area in the first instance.

v) For factories and business establishments, total pollutant control should be conducted on the pollutant discharge load. For newly built factories and business establishments, environmental measures for existing factories and business establishments should be pursued, as far as possible, to allow for the regional development, and a specific amount of new development activities should be authorized on condition that they introduce state-of-the-art environmental technology, considering the margin compared with the target load[5].

vi) Both the objective for managing the discharge load, considering the status of water quality and the variation of discharge load, and the total pollutant load control plan should be reviewed.

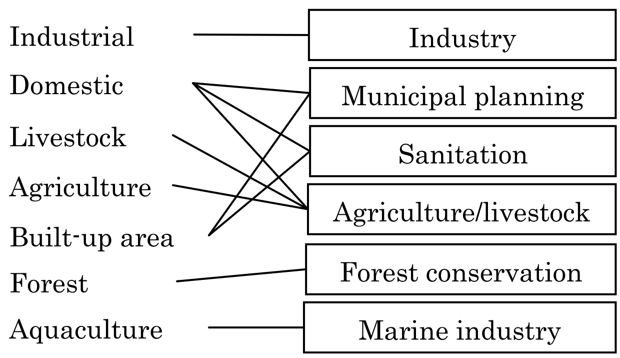
[5] This depends on the type of institution employed for constructing new factories and business establishments. Japan adopts a notification procedure, and when the contents of the notification do not meet the effluent standard or total pollutant control standard, the concerned prefectures provide instructions or program change orders. In the Seto Inland Sea, permits are given for the construction of factories and business establishments under the Law concerning Special Measures for Conservation of the Environment of the Seto Inland Sea.

Chapter 3 Development of institutions and frameworks for effective operation of the TPLCS

Water quality examination and assessment on the current status of the industrial structure or the regional characteristics need to be conducted to implement the TPLCS. It is important to design the TPLCS and to arrange for various related frameworks by making full use of available information. Since, in principle, the total pollutant load control addresses all sources and related administrative sectors cover a broad range, it is also important to establish coordinating and cooperative relationships with these sectors.

Table 3.1 summarizes the main related frameworks and institutions that need to be established for the implementation of the TPLCS.

Table 3.1 Frameworks and coordination with concerned agencies required for implementing the TPLCS

Items for implementation	Frameworks and coordination with concerned agencies
Reduction of total pollutant load	○ Survey on regional characteristics and industrial structure ○ Coordination and cooperation with the concerned administrative sectors Sources of pollutant load and concerned administrative sectors 
Quantitative assessment of pollutant discharge load	○ Collection of the data required for calculation ○ Effluent amount from pollution sources (point sources) and measurement of the concentration ○ Formulation of the calculation method for pollutant discharge load
Establishing the reduction objective for preserving the water quality of the water area	○ Establishing the aquatic environment objective (Environmental Quality Standards for Water Pollution) ○ Measurement of the water quality and flow volume in the water area (rivers, lakes/ponds, sea area) ○ Analysis of the pollution mechanism

	○ Surveys on the regional characteristics of the watershed area (natural geography, hydrology, meteorology)
Prediction on the increase of pollutant discharge load in future	○ Coordination and cooperation with planning sectors ○ Collection of information on the development plans in each country and region ○ Formulation of the calculating methods for increasing pollutant discharge load
The effluent control on the pollutant discharge load from factories and business establishments	○ Actual measurement of the effluents from factories and business establishments, surveys on the municipal wastewater treatment facility ○ Supervisory monitoring of factories and business establishments ○ Formulation of a new method for establishing the regulatory standards for pollutant discharge load
Others	○ Financing for the implementation of the system (coordination with financial sectors) ○ Understanding and cooperation on the measures for factories and business establishments, citizens and local communities ○ International cooperation

Chapter 3 describes the matters required for implementing the TPLCS. When the frameworks and institutions are being developed, they need to be adapted to the existing systems and administrative organizations in each country, and these frameworks and institutions need to be worked out in accordance with the situation of each country. Chapter 3 explains the systems and institutions of Japan as informative examples intended to help in developing each new system.

If the TPLCS were to be introduced at too late a time due to the lack of such related frameworks or inadequate amount of local information including the water quality, the aquatic environment problem will be worsened. If the progress of water pollution is too fast, it is important to first introduce the TPLCS, and then to resolve outstanding issues related to the frameworks in parallel with the implementation of the TPLCS.

3.1 Measurement of water quality

When initiating the TPLCS, it is necessary to quantitatively assess the pollutant discharge load for each source as well as the targeted water quality, the inflow/outflow water volume, and the resident water volume of the water area. If the actually measured data of the pollutant discharge load has been obtained in adequate amount, they should be used. If there are no such data or the available data are inadequate, it is necessary to take an actual measurement to collect the required data.

In addition, to implement the TPLCS, it is necessary to pay attention to the variance of the water quality and the inflow pollutant discharge load, and to measure the water quality and flow volume of rivers, lakes/ponds and sea areas so that reliable and continuous data can be obtained through arranging the systems and frameworks.

Column 5: Measurement of water quality and systems when the TPLCS was introduced in Japan

Before the TPLCS was introduced in Japan, related data were inadequate. As indicated in Chapter 1, 50% of the total amount of industrial COD emission has been reduced in the Seto Inland Sea since 1974. Before then, large-scale concurrent water quality examinations were conducted in May 1972. The number of measurement points used in these examinations was 709 for sea water quality, 203 for plankton, 107 for river water quality, 570 for factory effluent, and 295 for marine sediment. The measurements were conducted concurrently at the same period of time (within 2 hours' difference) of the same day, considering the flux and reflux. The concurrent water quality examinations were also conducted in July, October and January of the next year, from which four seasonal data were collected.

At present, the Water Pollution Control Law requires prefectures to monitor the status of pollution in the public water areas of rivers, lakes/ponds and sea areas on a full-time basis. The measurement plans are formulated by the Prefectural Governors in consultation with local administrative agencies, and the water quality and flow volume are measured in accordance with the plans.

The Director General for Water and Air Environment Division under the Ministry of the Environment has issued a directive to the Prefectural Governors in the assessment on the status of the aquatic environment in the targeted water areas and the measurement method of the water quality of the targeted water areas for establishing the Environmental Quality Standards for Water pollution. The contents of the directive are described in Reference Material 4.

3.2 Cooperation with concerned agencies and other entities

In principle, the TPLCS addresses all sources of pollution and seeks to reduce the pollutant discharge load. Therefore, the concerned administrative offices cover a wide range, and coordination and cooperation with these administrative sectors is required. Further, it is critical to establish coordination, collaboration and cooperation with various officials and bodies as shown below.

○ The TPLCS addresses a broad range of targets including factories and business establishments, domestic effluents, livestock, farmlands, and aquaculture. Therefore, coordination is required with related sectors in industry, agriculture, and municipal development.

○ To measure the water quality and volume of the water area, cooperation with the management sector of rivers, lakes/ponds and sea areas is also important.

○ Cooperation is also required with the planning and statistics sectors to obtain statistical data and to gain an outlook for the regions.

- ○ When collecting information on the topographic, hydrological and meteorological conditions, cooperation is required with land planning, survey engineering and meteorological sectors.
- ○ There are cases in which the TPLCS is implemented across multiple local jurisdictions such as when targeting a broad water area. Also, in inland local jurisdictions that do not face any sea area, total pollutant load control may sometimes be needed. In such cases, cooperation among the local governments and cooperation and division of roles between the national and local governments are important.
- ○ Coordination and cooperation need to be established with the concerned administrative sectors and with many stakeholders including companies, residents, and local communities.

Such coordination may be pursued in a variety of ways depending on the situation in each country, such as the political regime, administrative organization, local government system, status of the industry organization including trade groups, chamber of commerce and industry, and their relationships with the administrative agencies, and the status of local communities. In any case, it is important that the environmental sector play a central role in coordination activities, and commit their efforts towards implementing the required reduction measures effectively as a whole. To facilitate these coordination activities, it is also important to seek to enhance awareness about the necessity of environmental protection and the knowledge of water pollution, and to enhance the common awareness within the administrative sectors and the whole society.

It is indispensable for facilitating the implementation of the TPLCS to establish mutual confidential relationships and to secure collaboration and cooperation through these coordination efforts.

3.3 Development of institutions and frameworks for administrative supervision over factories and business establishments

A supervisory management program is required to capture the status of discharged pollutant load and the reduction measures by factories and business establishments, which discharge pollutant load into water areas. In addition, as the regulation based on the Total Pollutant Load Control standard calls for monitoring the status of compliance with the standard, it is necessary to measure, record and report the effluents from factories and business establishments, and to arrange the related frameworks and institutions.

Column 6: Supervisory management on the factories and business establishments in Japan

In Japan, the Water Pollution Control Law provides for various supervision and management systems for factories and business establishments. The system under the Water Pollution Control Law is described in Figure 1.4. The major systems excluding effluent control are as follows:

(1) Notification required when constructing a factory or business establishment that discharges pollutant load into the public water areas

When constructing a facility that discharges pollutant load into the public water areas (referred to as "specified facility" under the Water Pollution Control Law in Japan), the Prefectural Governors must receive notification of following items:

- Name and address, and in case of a corporate body, name of the representative person (of the business entity that discharges water into the public water areas through the factory or business establishment)
- Name and location of the factory or business establishment
- Type of the specified facility
- Structure of the specified facility
- Use of the specified facility
- Treatment method of the wastewater
- Condition and amount of the effluent (the TPLCS stipulates that notification must provide the condition and amount of effluent for each effluent system)
- The water systems related to the effluent and the effluent system

Upon receiving the notification, the Prefectural Governor may order the revision or abolishment of the plan, if the governor finds that the plan does not meet the effluent standards or the Total Pollutant Load Control standard. (For the Seto Inland Sea, the Prefectural Governors may grant permission. The Prefectural Governors may not grant permission if the effluent or wastewater from the concerned facilities could cause considerable harm to the environment of the Seto Inland Sea.)

(2) Measurement of the water quality of the effluents from factories and business establishments

To comply with the total pollutant load control standard, the factories and business establishments must measure and record the pollution status of the effluents as prescribed in the Water Pollution Control Law.

In Japan, the total pollutant load control standard addresses the discharge load for each day from factories and business establishments. Factories and business establishments are required to estimate the daily discharge load.

Measurement frequency is stipulated by the unit of effluent amount as shown in Table 3.2.

Table 3.2 Measurement frequency of discharge load at factories and business establishments in Japan

Effluent amount	Not less than $400m^3$/day	Not less than $200m^3$/day Below $400m^3$/day	Not less than $100m^3$/day Below $200m^3$/day	Not less than $50m^3$/day Below $100m^3$/day
Measurement frequency	Everyday	Not less than once in seven days	Not less than once in 14 days	Not less than once in 30 days

For measurement and recording, the factories and business establishments discharging effluent at a rate of not less than $400m^3$/day must make automatic sampling, measurement, and recording. (Regarding the pollution status (concentration), sampling, transportation to the measuring device, measurement, and recording are all conducted automatically. Regarding the flow volume, the water volume is automatically estimated with a flow meter or a velocimeter and the result is automatically recorded.) In cases where measurement with automatic meters is not considered technically appropriate, a composite sampler (a device that collects samples at a predefined sampling ratio in proportion to the effluent amount and stores the samples without changing the water quality to automatically capture the average water quality per specified time duration) must be used to automatically collect the samples. The data must be manually analyzed in accordance with the measurement method specified separately by the Minister of the Environment[6].

It is considered desirable even for those business establishments with effluent below $400m^3$/day to as much as possible automate the measurement process.

The records of such measurement must be retained for 3 years.

The concerned Prefectural Governor must be notified about the measurement method. Notification is also required when changing the measurement method. The notification items are as follows:

- The COD contained in the effluent, pollution status of the nitrogen and phosphorus content, the measurement method for the items required to assess the effluent amount and other pollutant discharge load, and the measurement points
- The measurement method for the daily pollutant discharge load contained in the effluent
- Other items concerning the measurement method for the pollutant discharge load, which should serve as references

The Director General for Water and Air Environment Division under the Ministry of the

[6] The specified measurement methods are the methods specified in the Japanese Industrial Standards (JIS).

Environment has issued a directive to the Prefectural Governors for the method of measuring the effluent from factories for the purpose of establishing the Environmental Quality Standards for Water Pollution. The major points of the directive are as follows:

i) Measurement frequency of the water quality

Water samples should be collected and analyzed on at least 4 days per year.

ii) Time of measurement

The effluent from factories and business establishments should be considered in addition to their operating conditions and seasonal variation in the effluent.

iii) Selection of the sampling points

An effluent outlet should be selected as the sampling point. If it is impossible to collect samples at the outlet, the outlet of the final effluent treatment facility should be selected. The selected outlet is where effluent samples can be collected and the collected samples are the same quality as those collected at the effluent outlet.

To calculate the treatment efficiency, if a wastewater treatment facility is installed for wastewater treatment, measurements must be taken at some point before wastewater treatment facility installation as needed.

iv) Items required to be conducted at the time of sampling

The sampling date, effluent volume, and the biota in the vicinity of the effluent outlet must be recorded. The water temperature, turbidity, odor and transparency should be measured or observed on the spot.

(3) Instructions on reporting the required information given by the supervisory agency

The Prefectural Governor may require the factories and business establishments to report the condition of the equipment that causes the pollutant load, methods for treating the wastewater, and other required information to the Governor. Additionally, the Governor may require factories and business establishments to report on the treatment methods of the wastewater/waste liquid and on other required information under the TPLCS. The Governor may also order concerned officials to conduct an on-the-spot inspection. In such cases, the factories and business establishments must respond to the requirement.

3.4 Promotion of efforts by factories and business establishments to reduce discharge loads

Factories and business establishments are regulated for their total discharge load, and since the discharge load can be reduced only if they comply with the regulation, various efforts have to be made to urge the factories and business establishments to comply with the total pollutant load control standard. An important way to urge factories and business establishments is the supervisory management described in section 3.4, and other points to take notice of will be described below.

(1) Establishing the total pollutant load control standard for the discharged amount of pollutant load

As the values of the total pollutant load control standard are established with a view to reduce the discharged amount of pollutant load, the standard values must be complied with. For that purpose, it is critical to establish standard values that can actually be complied with and to arrange for the frameworks that will allow for the compliance with the standard values established in this way, considering technological and economic conditions as needed.

In Japan, the status of effluents from factories and business establishments is surveyed and assessed in establishing the total pollutant load control standard, and the standard values are determined on the basis of such status. Consequently, the standard values have been established at a level which can be complied with based on the present technological standards. In addition, to promote compliance, the government provides technical instructions to support compliance, and grants low-interest loans for small and mid-sized businesses with low funding ability. With these efforts, the total pollutant load control standard has been almost completely complied with, and the pollutant discharge load has been steadily reduced.

(2) Promotion of voluntary efforts by factories and business establishments

To promote compliance with the total pollutant load control standard, each country should prescribe fines and penalties for violating the standard, but the important thing is to steadily reduce the discharge load by promoting compliance with the standard rather than to impose penalties, and the efforts for that purpose have important implications. The means to enforce factories and business establishments to comply with the standard include, in addition to administrative supervisory management, various means such as administrative technical instruction, supportive measures including assistance for fund-raising efforts, and enhancement of social normative consciousness. It is important to pursue comprehensive development by combining such efforts in accordance with the situation in each country or region.

Column 7: Examples of promoting measures for the voluntary efforts of factories and business establishments in Japan

To promote the voluntary efforts of factories and business establishments, the following policies have been implemented in Japan.

a. Administrative instructions for factories and business establishments: This measure has proved to be effective especially for small and mid-sized business establishments with limited technological ability. When total nitrogen and total phosphorus were added to the items addressed under the TPLCS in 2002, "A manual on effluent measures for small-sized business establishment" was created and published for promoting small and mid-sized business establishments, and the manual was utilized in administrative instructions on related technology.

b. Assistance for fund-raising efforts to install wastewater treatment facilities: Regarding the installation of pollution control devices, preferential policy loans including low-interest loans were granted mainly to small and mid-sized companies. In addition, tax benefits for corporate taxes were also enacted.

c. Social normative consciousness: In Japan, there is a strong call for corporate social responsibility, and companies are socially inhibited from violating the standards for the environment including the effluent standard. If companies violate the standards, they will be subject to adverse conditions in loan agreements with financial organizations, or in their relationships with customers, local governments, local residents, and consumers, which at times lead to adverse influence on factory operations.

(3) Utilization of industrial structure adjustment policies

Technical instructions and assistance for fund-raising efforts described in section (2) are provided for small and mid-sized business establishments, such as domestic industries and individual shops. Meanwhile, industrial structure adjustment policies, such as close-down recommendations, could be implemented for those business establishments that are operating aging equipment and using old-fashioned technologies with little room for improvement. Some countries are already implementing such measures. These policies are widely adopted to construct industrial complexes equipped with effluent treatment facilities and to stimulate the relocation of factories and business establishments.

These policies, including industrial structure adjustment and relocation of factories and business establishments, seek to reduce the discharge load. Although Japan has never employed industrial structure adjustment, the Environmental Pollution Control Service Corporation and others used to implement measures for assisting and promoting the relocation of factories and construction of industrial complexes.

3.5 Implementing measures against domestic effluents

When implementing the TPLCS, it is also important to reduce the domestic discharge load by treating the domestic effluent. Installation of treatment facilities such as sewage systems and Johkasous are pursued to treat the domestic effluent, but these efforts need to be pursued in accordance with plans as a part of social infrastructure development.

In Japan, the Waste Management and Public Cleansing Law provides that municipalities must formulate plans for treating municipal solid wastes, as a part of which the Basic Plan for Domestic Effluent is formulated. This is a basic plan for domestic effluent treatment from the long-term standpoint of 10 to 15 years, and provides the basic policies for domestic effluent treatment, including the methods and extent of the domestic effluent treatment, and the methods of treating sludge generated in the treatment process of the domestic effluent. The plan provides for the following items:

i) The targeted treatment ratio of domestic effluent
ii) The areas where the domestic effluent treatment is conducted. A treatment method should be determined for each area and indicated on the map.
iii) Construction plans of domestic effluent treatment facilities
iv) Awareness raising and guidance for the public
v) Treatment plans for night soil and sludge

Under the Water Pollution Control Law, the priority areas for domestic effluent measures are to be specified in those water areas where water pollution has so worsened that it is impossible, or it is likely to be impossible, to meet the Environmental Quality Standards for Water pollution, or where preserving the water quality is of special importance, if it is considered particularly necessary to promote the implementation of the domestic effluent measures. The Municipal Mayors formulate the program for promoting the domestic effluent measures for the priority areas for domestic effluent measures, and the program establishes the construction of domestic effluent treatment facilities, awareness-raising activities related to the domestic effluent measures, and other required items.

Promotion of domestic effluent measures is a challenge in East Asia, and a systematic effort is being sought to implement measures beginning with high-priority areas. Consequently, the need is to formulate plans for promoting such domestic effluent treatment and steadily implement domestic effluent measures.

In formulating the plans, the following points should be considered:

i) The current population, the status of domestic effluent treatment, the installation status of domestic effluent treatment facilities including sewage systems and Johkasous, and the urgency of domestic effluent treatment.

ii) When deciding the treatment method (whether to adopt centralized treatment with sewage systems or individual treatment) considering the geographical conditions and population density of each area, it is also necessary to consider the correlation between the cost and the scale of treatment for each treatment method and the financing for construction.

iii) The opinion of the local residents as well as the compatibility with the traditional treatment methods and the environment of each locality.

iv) The time period required from the construction of the facilities until the commencement of their operation.

v) Various methods of domestic effluent treatment and their characteristics.

vi) The outlook for development, including population growth and improvement in living standards in the future.

vii) Domestic effluent treatment methods include sewage system, small-scale sewage system and Johkasou. These facilities should be used properly in accordance with the attributes (installation cost, maintenance/operating cost, effects of reducing the pollutant discharge load, and time period required to install the related equipment). In Japan, the facilities are used as shown in Figure 3.2.

viii) It is also important to initiate the measures on a preferential basis in those water areas where there is an urgent need for the measures and where the amount of pollutant discharge load is large.

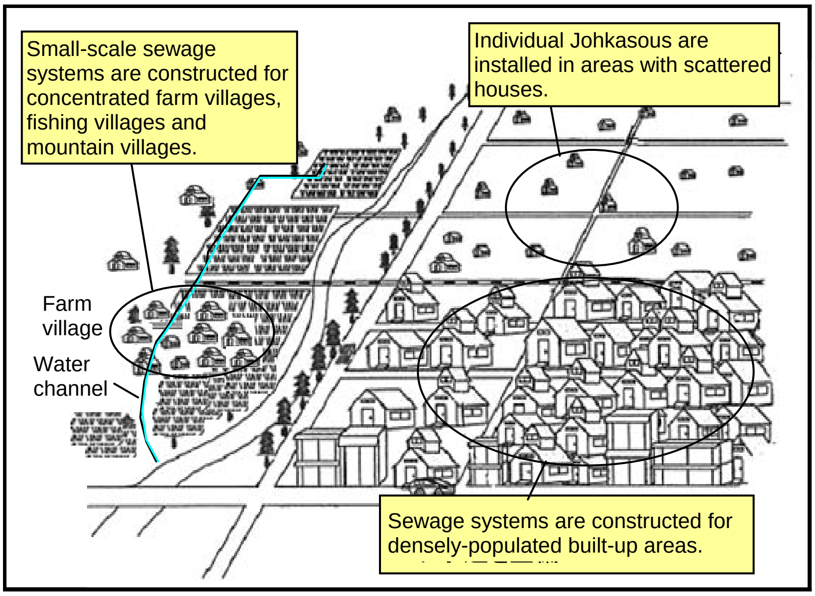


Figure 3.1 Use of domestic effluent treatment facilities in accordance with their attributes

3.6 Other related matters

(1) Promotion of water quality examination and research in water areas

To examine the influence of the total pollutant load control on the improvement of the water quality of the targeted water area, it is important to verify the effect of the TPLCS by conducting water quality examination. Pollutant load is often found deposited on the bottom sediment, and the bottom sediment needs to be examined together with the water quality examination.

In implementing the TPLCS, in relation to the analyses on the calculation of the pollutant discharge load in the watershed area and the relationship between the pollutant discharge load and the water quality of watershed area, much of the research includes elements of academic research. These elements include the establishing of the basic unit for calculating the outflow load from plane sources of farmlands and assessment of natural purification capacity, understanding of the pollution mechanism, and development of wastewater treatment technologies.

In addition to the promotion of surveys and research, collaboration with concerned research institutes is also important to implement the TPLCS in a more scientific manner.

(2) Financing

To implement the TPLCS, which will entail the cost for conducting water quality measurement and related surveys, it is necessary to consider financing for those activities.

Factories and business establishments need to construct effluent treatment facilities and to operate appropriate treatment facilities for the purpose of reducing pollutant discharge load. In principle, the cost for these facilities must be borne by the business operators as an indispensable cost for implementing the project in Japan. Supportive measures such as low-interest loans are provided for factories and business establishments as policy measures, which have been applied to small and mid-sized businesses with low funding ability. Many in the past used to consider it important to seek harmonization between the environment and economic growth in Japan, but after the Basic Law for Environmental Pollution Control was revised in 1970, when environmental pollution had become serious, the concept was changed into one of giving priority to environment preservation over economic growth[7]. Therefore, Japan does not go along with the idea of setting aside antipollution measures because of financing difficulty.

In addition, public works are conducted to cope with domestic effluents, including the construction of sewage systems. These works also need resources, and in recent years some countries have begun to introduce the system of utilizing private funds for public works through Private Finance Initiative (PFI), Build Operating Transfer (BOT), and Public Private Partnership

[7] Article 1 of the Basic Law for Environmental Pollution Control (the former law of the Basic Environment Law) provided that "Preservation of living environment shall be sought in harmony with sound economic development...." This was called the "harmonization clause" and was abolished by the revision in 1970.

(PPP) .

(3) Developing and securing human resources

For the purpose of smooth implementation of the TPLCS, the need is development of human resources with specialized knowledge on the preservation of aquatic environment and wastewater treatment.

In Japan, the law mandates that each factory that generates pollutants must organize a pollution prevention system and have a pollution control manager. The pollution control manager, as an engineer with specialized knowledge and familiar with the systems related to water quality preservation, contributes to voluntary pollutant load reduction at factories and business establishments. The system of pollution control manager was initiated in fiscal year 1971, when environmental problems became obvious in Japan, and the number of examinees in the first year of the national exam for pollution control manager was above 100,000.

(4) Public relations activity and education and public awareness activity

To promote the TPLCS, each member of the public, businesses and concerned local administrative agencies are required to increase their awareness of water quality preservation and to implement activities for preventing water pollution. For that purpose, public relations activities and education and public awareness activities play an important role.

The following efforts are being pursued in Japan:

- ○ Business entities are required to be familiar with the effect and contents of the total pollutant load control plans and to make efforts and to cooperate with others with a view to meeting the total pollutant load control standard and reducing pollutant discharge load through various organizations and workshops.
- ○ Citizens are encouraged to enhance their awareness of domestic wastewater measures that can be taken at home and knowledge of water pollution through a variety of publication methods including pamphlets and various forums.

Reference Material 1: Japan's experience in water pollution and countermeasures

Japan has experience with exacerbated aquatic environment along with economic growth, which led to serious water pollution, and overcoming it to some extent by taking measures. Some helpful points in this history will be briefly described with a central focus on the TPLCS.

(1) Economic development and occurrence of serious water pollution problems

In Japan, industrial production began to increase from the late 1950s and the economy grew rapidly. Economic growth rate reached a yearly average of 9.1% from 1956 to 1973, and industrial production grew to approximately threefold in terms of the (price-adjusted) value of shipments from 1960 to 1975. In addition, the per capita GDP also showed a rapid growth. The economic growth rate and per capita GDP of Japan at that time were almost at the same level as China and East Asian countries are, and Japan appears to have been at almost the same stage of development as these countries.

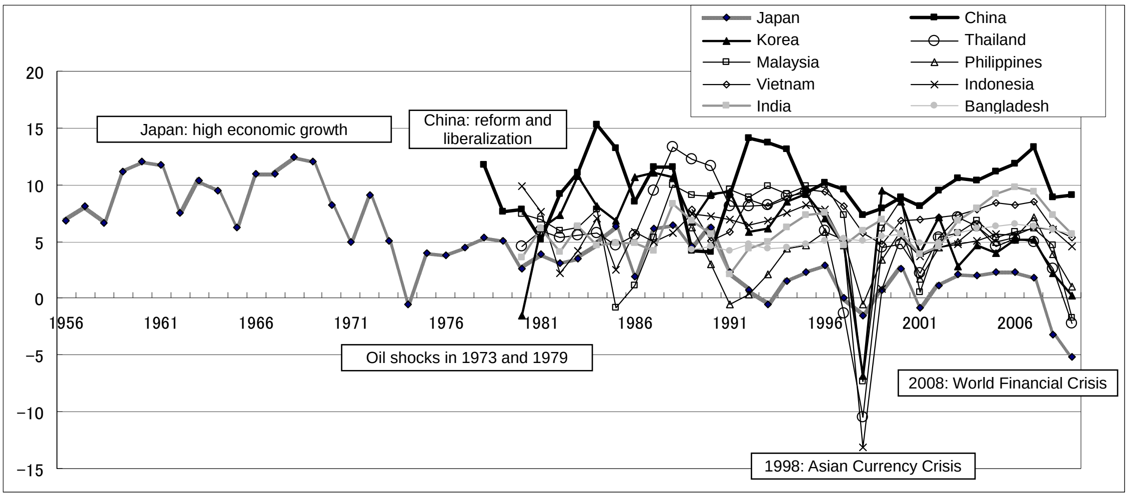


Figure A.1 Transition of economic growth rate in Japan and East Asian countries

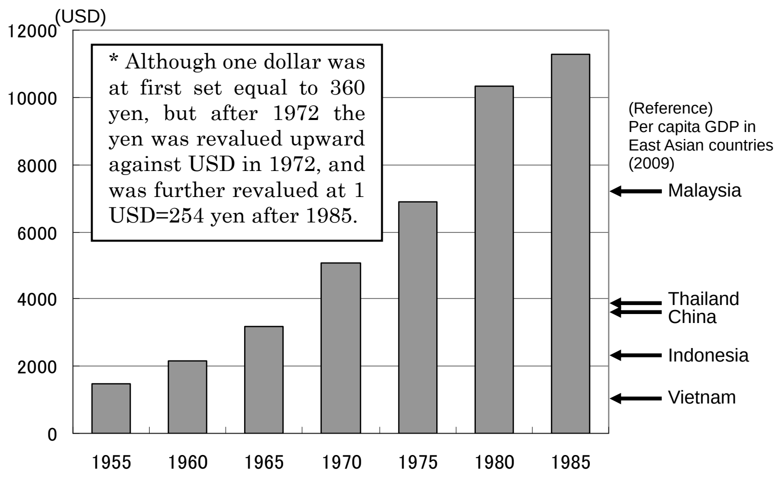


Figure A.2　Transition of the per capita GDP of Japan (price-adjusted and dollar-based)

This period of time is called the period of high economic growth in Japan. This period saw economic prosperity as well as worsening pollution problems including water pollution and air pollution.

At that time, considerable economic development was in the region called the Pacific Belt Zone, as shown in Figure A.3. One after another factories were constructed, and the population was also concentrated in this region. The population density of the urban areas of Japan in 1970 was 8,689 people/km^2. Owing to such industrial development and population concentration, a large amount of pollutant load was generated, and this caused serious water pollution in many parts of the country. Some examples are shown below.

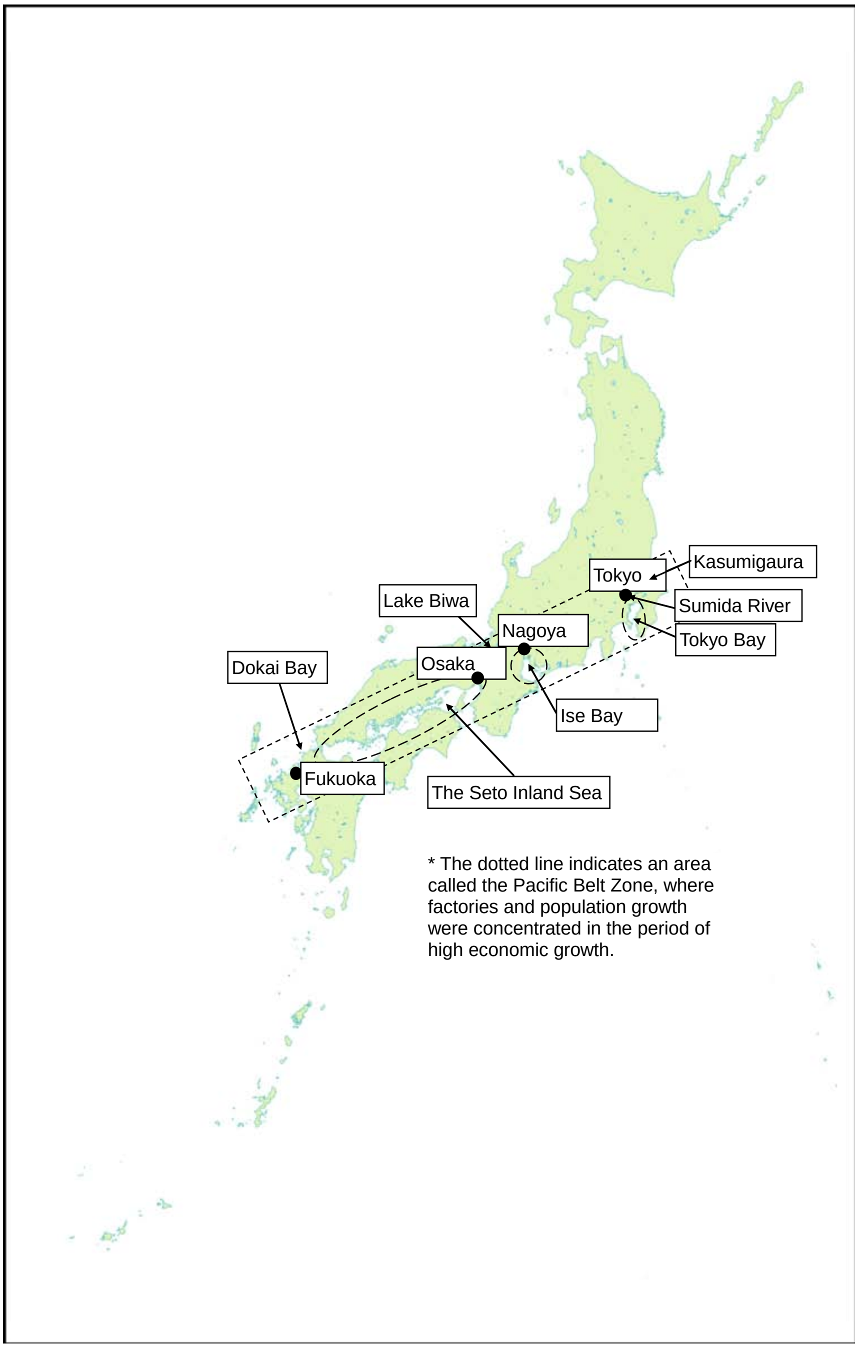


Figure A.3 Examples of regions where water pollution was generated

i) The Sumida River: The Sumida River, a municipal river, is a diversion from the Arakawa River and it runs through the urban area of Tokyo into Tokyo Bay, with the population of 4.3 million people in the watershed area. Its stream gradient of 1/10,000 is on a moderate level, and it has a high stagnation property under the influence of the flux and reflux, to such an extent that 3 to 4 days are needed for the stream water to run the distance of 23.5km from the diversion point from the Arakawa River to the mouth of the Sumida River. Icefish and fresh water clams used to be caught in the river, but the water quality worsened because population growth and increased construction of chemical plants and dye works upstream of the river caused domestic effluent and industrial effluents to be discharged into the river in great amounts without treatment or adequate treatment. In 1962 the BOD was measured as high as 63mg/l, and the toxic gas generated from the river discolored the famous gold-copper Buddhist statues of the nearby Sensoji Temple. Later, by means of the expansion of urban sewage systems and the effluent control/relocation measures implemented on factories, water quality was gradually recovered. At present, the BOD is 5mg/l, a level that generally meets the Environmental Quality Standards for Water Pollution.

ii) Dokai Bay: Dokai Bay is a small inner bay with 13km in length and 7m in average depth. It is located in Kitakyushu, a typical industrial city of Japan. During its high season in the past the bay was forested with as many as 1,032 factories for iron works, metal working, machinery, shipbuilding, chemistry, ceramic engineering, cement, and foodstuff, among others. Untreated industrial effluent from these factories caused serious water pollution. According to surveys conducted in 1968 to 1969, the situation had deteriorated to such an extent that the maximum value of the COD was 74.6mg/l and the dissolved oxygen was 0, at which level Dokai Bay was called the “sea of death.” Some said that the pollution could cause the screws of the ships in the bay to melt. In Dokai Bay, most of the inflow load was brought in by the effluents from factories. Effluents from factories accounted for 98% of the total discharged COD load. Mounting concerns over the water quality raised company awareness, and in one factory after another effluent treatment facilities were constructed. In addition, dredging eliminated the polluted bottom sediments. As a result of these measures, the water quality was rapidly recovered, so that in 1973, the water quality met most of the environmental standard values.

iii) The Seto Inland Sea: The Seto Inland Sea, surrounded by Honshu, Shikoku and Kyushu, is an enclosed sea representative of Japan. It has an area of 23,203km^2, with a population of approximately 30 million people in the watershed area. Since ancient times, its scenic beauty has been appraised and mentioned in Japanese poetry. The Seto Inland Sea used to be rich in fishery resources. However, during the period of high economic growth, iron work, shipbuilding, and petrochemical factories were constructed in large numbers along the coastal areas of the Seto Inland Sea, and the discharged industrial effluents caused the water quality to degrade again. Landfilling operations for plant sites caused the natural coasts to decrease. Red tides began to appear from the late 1950s, and later they gradually spread across the Seto Inland Sea, causing fishery damage to spread. At that time, the Seto Inland Sea was called the sea of death. In 1972, red tides caused debilitation and death to 14 million aquacultured yellowtails. Fisherfolk filed a lawsuit for damages and an injunction order to restrain the factory effluents against the national government, the two municipalities that were dumping night soil in the Harimanada and the ten companies that were discharging factory effluents. In the Seto Inland Sea, 50% of the COD pollutant discharge load contained in industrial effluents has been reduced since 1973, leading to the significant decrease in the number of red tide occurrences. Since 1979, the TPLCS has been implemented on an ongoing basis. The trend of degrading water quality was checked, and the quality has been improving.

iv) Lake Biwa: Lake Biwa is the largest lake in Japan with an area of 670km^2. Until around the 1930s, it was called an oligotrophic lake, and the Hokko (the Northern Lake) was observed to have a transparency of not less than 10m. However, due to population growth, industrial development and modernization of people's lives, the increase of inflow pollutants became evident from around the late 1960s. As a result, the water quality so deteriorated that filtration failure began to be observed in purification plants from around 1960. From around 1970 tap water had a foul odor and bad taste. In addition, from around 1972 red tides began to appear, leading to a major outbreak in 1977. From 1983 blue-green algae began to be observed off the coast of the Nanko (the South Lake). This environmental deterioration enhanced the awareness of the citizens to protect Lake Biwa, and to reduce the entry of phosphorus, which was the cause of red tides, a voluntary restraint campaign was initiated against the use of detergent phosphate. Triggered by these heightened campaign activities, the Ordinance on the Prevention of Eutrophication of Biwa-ko[8] was enacted in 1980, which banned the marketing and use of phosphorus-containing household synthetic detergents. Additionally, effluent control measures targeting nitrogen and phosphorus started to be implemented for factories. Then in 1984, a comprehensive effort was initiated under the Law concerning Special Measures for the Preservation of Lake Water Quality. By now, the deteriorating trend of the water quality has been halted, and water quality is improving.

(2) Initiation of aquatic environment measures and their development

Under these circumstances, it was around 1970 when the high rate of economic growth was nearing its end that the countermeasures took on a specific form.

The Basic Law for Environmental Pollution Control was enacted in 1967 and the Environmental Quality Standards for Water pollution were established for the public water areas across the country. The Water Pollution Control Law was enacted in 1970, and effluent standards were established as well as application of direct penalty provisions against the violators of these provisions across the country in parallel with the regulation on industrial effluents. At the same time, as provided under these laws and regulations, when constructing new factories and expanding existing ones, the operators were required to provide notification on the status of the effluent amount, pollution status of the effluents, and the methods of treating wastewater. If their wastewater treatment projects were inadequate, the Prefectural Governors could instruct or order the factories to change the plans.

The Interim Law for Conservation of the Environment of the Seto Inland Sea was enacted because of the Seto Inland Sea, which was called the sea of death because the water quality was critical in

[8] In Japan, the laws formulated by prefectures and municipalities within the range of the national statutory systems are called ordinances.

1973, and because of appeals from the 11 coastal prefectures and 3 major municipalities to the national government. This law, which was formulated especially for the Seto Inland Sea, provides for 50% reduction of the COD load contained in industrial effluents, which may be regarded as the first of Japan's new concept of the TPLCS. To preserve the water quality of the Seto Inland Sea, it was considered necessary to reduce the discharge load in a reliable and prompt manner targeting the factories identified as a major source of pollutants.

The method adopted for reducing the total pollutant load was to assign reduction amounts to 11 prefectures, which would then establish effluent standards for meeting the assigned reduction amounts and implement the standards. Since the data were required on the effluent amount from factories and the water quality to put these tasks into practice, the 11 coastal prefectures and other bodies conducted concurrent surveys on the water quality at approximately 1,900 points in the effluent from factories, rivers and sea areas. Meanwhile, as the pollutant discharge load for each prefecture, which would be used as the basis for the reduction, had not yet been calculated, this was later calculated using the following method: First, the effluent amount for each category of business was obtained by multiplying the average value of shipments for each category of business in the concerned prefectures by the average industrial water amount, and subtracting the amount of evaporation loss from the amount. Then the effluent amount obtained for each category of business was multiplied by the average water quality of the effluent for each category of business to find the pollutant discharge load. In this way, measures for reducing the COD contained in industrial effluents by 50% began to be implemented in 1974. The aim was to achieve the objective in 5 years. The result was that the water quality improved and from then on continued to improve.

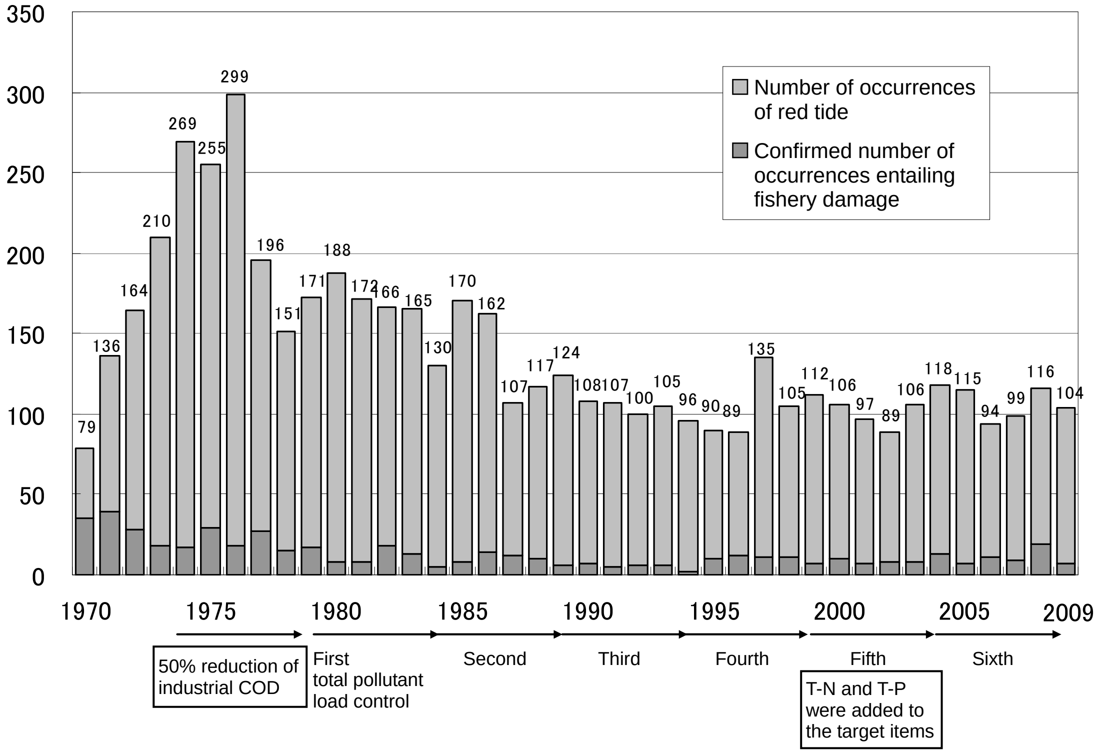


Figure A.4 Transition of the number of red tide occurrences in the Seto Inland Sea

In the 1970s, investments by companies for pollution prevention equipment rapidly increased, and implementation of the countermeasures made progress in actual terms. This was because, in addition to a heightened sense of crisis toward environmental problems in the whole society, companies, on their part, gathered momentum for implementing pollution prevention measures from the viewpoint of social responsibility, and supportive measures were also established including low-interest loans by governmental financial institutions and tax credits.

For the treatment of domestic effluent, construction of sewage systems was pursued in accordance with the plans. Sewage systems have various purposes including the discharge of municipal rainwater and public sanitation, but by the revision of the Sewage Law in 1970, preservation of the water quality of public waters was explicitly stipulated as a purpose of sewage systems. In 1970, the installation rate of sewage systems was only 16%. As a result of continuous fund injection for constructing sewage systems at an annual average ratio to GDP of 0.6 to 0.7% during the time from 1975 to 2002, the diffusion rate reached 65% in 2002. Moreover, installation of small-scale sewage systems has been pursued in rural areas.

Thanks to these efforts, degradation of the Japanese aquatic environment was repressed, and took a turn for the better.

(3) A full-scale introduction of the TPLCS

In Japan, a full-scale introduction of the TPLCS began under the Water Pollution Control Law and the revision of the Law concerning Special Measures for Conservation of the Environment of the Seto Inland Sea in 1979. The overview of the TPLCS can be described as follows:

i) Total pollutant load control was implemented in enclosed seas, broad public waters where effluents from domestic and business activities due to population and industrial concentration flow in in great amount, if it was difficult to meet the Environmental Quality Standards for Water pollution by effluent control alone (targeted areas were specified in Tokyo Bay and Ise Bay, in addition to the Seto Inland Sea).

ii) The reduction objective for the target fiscal year was established by calculating the total pollutant load for each source in industrial, domestic, and other sectors (agriculture, livestock, forest, built-up areas, and aquaculture).

iii) The reduction objective was the amount that was aimed to be reduced as far as practicable in consideration of the trend of population and industry, the treatment level of wastewater or waste liquid, and outlook for the construction of sewage systems.

iv) When implementing the TPLCS, the Minister of the Environment formulated the TPLCS Policy which specified the reduction objective for each prefecture (including the capital city). Based on this, each Prefectural Governor formulated a total pollutant load control plan that contained the reduction objectives for each source and methods of attaining the objectives.

v) In combination with these, the Minister of the Environment specified the range used in setting the C-values for the business-category-based Total Pollutant Load Control Standards for factories and business establishments.

vi) The prefectures (including the capital city) formulated their own business-category-based Total Pollutant Load Control Standards for factories and business establishments to be regulated, on the basis of their own total pollutant load control plans, within the range specified by the Minister of the Environment.

However, at that time it was yet technically difficult to automatically and directly measure the factory effluents, and the system for supervisory monitoring was not fully established. The people involved in this system were aware that several challenges existed like those listed above in actually operating the system. However, in light of the urgency of preserving water quality, it was decided that the institutionalization of the TPLCS needed to be pursued promptly and implemented steadily, in parallel with the effort to overcome the challenges. The first phase of the TPLCS was initiated in 1980. Regarding the challenges, the measures were implemented during the first phase of the TPLCS.

The target year of the first phase of the TPLCS was established for 1984 (5 years later), and in the later phases each target year was established for every 5 years, continuing the TPLCS up to this time.

At the time of the first phase of the TPLCS in 1979, the target item of total pollutant load control was limited to COD alone. Although the total pollutant load control for nitrogen and phosphorus, which were the cause of eutrophication, was also required to protect the aquatic environment of enclosed seas, because the scientific knowledge on the influence of nitrogen and phosphorus on water quality was limited and the technology for effluent treatment to eliminate the pollutants was immature at that time, these elements were excluded from the targets of the regulation. However, it was recognized that nutrients-reduction measures were required. The reduction was pursued by administrative directives for factories and business establishments[9]. At the time, the discharge load of nitrogen and phosphorus also began to be reduced, owing to the combined effect of the increased use of phosphorus-free detergents and development and marketing of phosphorus-free detergents by detergent makers in response to the reduction directives, in addition to the awareness for preserving aquatic environment raised among consumers. Nitrogen and phosphorus were added to the target items of the 5th TPLCS, which was initiated in 2001.

As a result of these efforts, pollutant discharge load has been steadily reduced. The degradation of the marine aquatic environment has been restrained, and the environment has been improving. The pace of improvement, however, is slow and takes a long time. The reason is considered to lie in the fact that since the nutrients have been accumulated in large amount on the bottom sediment in the past and they liquate out from the sediment. Even if the newly flowing-in pollutant discharge load has been reduced, it is taking a considerable time for the water quality to improve. Recently, the water quality has been improved rapidly in some parts of the Seto Inland Sea, and it is becoming of concern that at some seasons of the year they lack the nutrients for laver cultivation. Regarding these sea areas, it is now being discussed that a radical change of perspective might be necessary from simply reducing the pollutant discharge load to managing the total pollutant to maintain a certain level of nutrients.

[9] The government provided instructions on the reduction of phosphorus in the Seto Inland Sea from 1980, and nitrogen was added to the target items in 1996. From 1982, the government provided instructions on the reduction of phosphorus in Tokyo Bay and Ise Bay.

Reference Material 2: Calculating method of pollutant discharge load

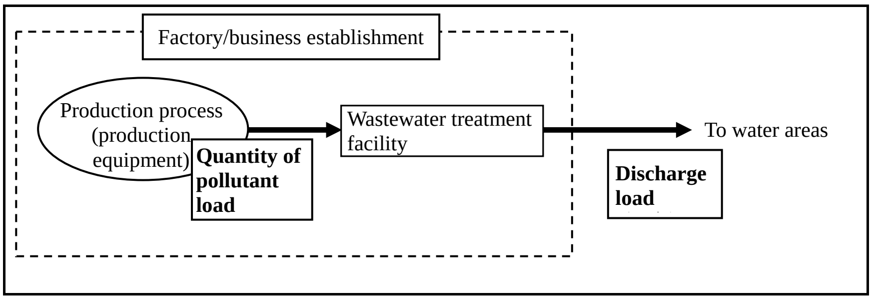
When calculating pollutant discharge load, the sources should be classified into 7 categories (industrial, domestic, livestock, farmland, built-up area, forest, aquaculture). The discharge load for each category should be calculated.

Actually measured data should be used for calculating discharge load as far as they are available. If data are not available, the pollutant discharge load per livestock head and the square measure of farmland should be established as the basic unit to be used in the calculation.

(1) Calculation method of discharge load

i) Industrial source

Capture the discharge load for each factory or business establishment (calculate — Effluent amount × Concentration = Discharge load — for each factory or business establishment). If the factory or business establishment does not have its own effluent treatment facility and the effluent is discharged without treatment, the quantity of each pollutant load is the discharge load.



- ○ The business establishment in relation to which data are available on the effluent amount and concentration: Use the data to calculate the discharge load.
- ○ The business establishment in relation to which no data is available on the effluent amount and concentration: The discharge load from the type of business and production items of the business establishment should be calculated by means of the ratio method. Depending on the situation, the following methods may be applied:
  - The effluent concentration is known, but the effluent amount is not.

    The effluent amount should be estimated from the industrial water consumption.
  - The effluent amount is known, but the effluent concentration is not.

    The effluent concentration of each factory should be estimated from the effluent concentration of a factory of similar type of business, and the quantity of pollutant load should be calculated. If the factory is not equipped with any wastewater treatment facility, the quantity of the pollutant load is the discharge load, but if the factory is equipped with such facility, the discharge load is multiplied by the rate of elimination by the wastewater treatment facility (called extraction rate). The extraction rate is estimated from each wastewater treatment method.

- If neither the effluent amount nor the concentration is known.

  The quantity of pollutant load per production or value of production for each type of business should be established as the basic unit and used for the calculation.

  The basic unit needs to be decided based on grounds. For that purpose, effluent data for the representative factories and business establishment should be collected. The basic unit should be established based on the data. If necessary, actual measurement of the effluent, as far as possible, should be taken.

For factories and business establishments, it is necessary to consider not only factories but also other facilities that generate pollutant discharge load. These facilities include eateries, hotels, shops, auto repair shops, gas stations, laundries and hospitals.

ii) Domestic source

Domestic effluent is classified into night soil and other domestic effluents (called domestic wastewater). Night soil has a high concentration of pollutants, and this is treated also from a standpoint of public sanitation. Domestic wastewater is the effluent from cooking, laundry, bathing, and cleaning, and has a lower concentration of pollutants than night soil. Therefore, in some cases night soil is separated from domestic wastewater and only night soil is treated. This is also the case in some instances in Japan.

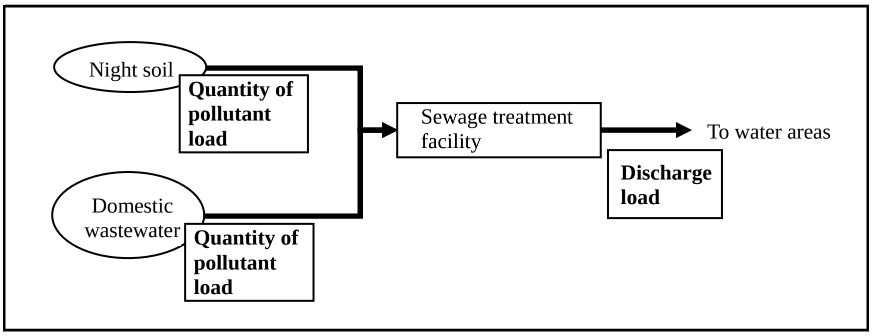
First, the basic unit for per capita quantity of pollutant load should be established. As the basic unit differs depending on differences in eating habits and lifestyles, if a basic unit has not yet been established, it is desirable to specify the basic unit by taking actual measurement, but other basic units used in Japan or other countries may be of reference. The basic units used in Japan are as follows:

Table B.1 (Reference) Commonly used basic units for domestic quantity of pollutant load in Japan (g/person/day)

	COD (Mn)	Total nitrogen	Total phosphorus
Night soil	10.1	9.0	0.77
Domestic wastewater	19.2	2.8	0.41

In Japan, domestic effluent treatment is classified into four types, and discharge load is calculated based on the target population for each type. The calculation method of discharge load for each type is described below.

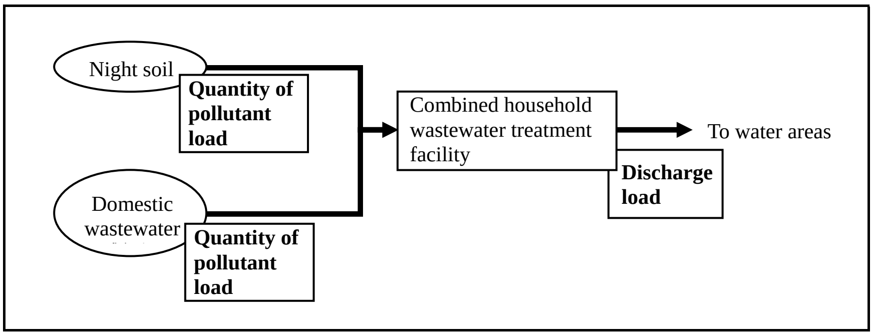
a) Treatment at sewage plants: The wastewater is transported via conduits of sewage systems to sewage plants for treatment.



○ The measured data of effluents from sewage plants should be used.

○ If effluent data is unavailable, the quantity of pollutant load may be calculated from the target population of the sewage systems. After setting the extraction rate from the treatment method of sewage treatment facilities, the discharge load can be calculated.

b) Treatment at combined household wastewater treatment facilities: In the areas where sewage systems are not constructed, Johkasous are installed for each household or several households to treat the wastewater. Among these Johkasous, the one that treats both night soil and domestic wastewater is called a combined household wastewater treatment facility.



○ The measured data of the effluents from combined household wastewater treatment facilities should be used.

○ If no effluent data is available, the data should be calculated using the ratio method. In that case, after calculating the quantity of pollutant load, the extraction rate should be estimated using the treatment method of Johkasou and the ratio method calculation should be conducted.

○ The typical extraction rates used in Japan are COD = 80%, total nitrogen = 25%, and total phosphorus = 35%.

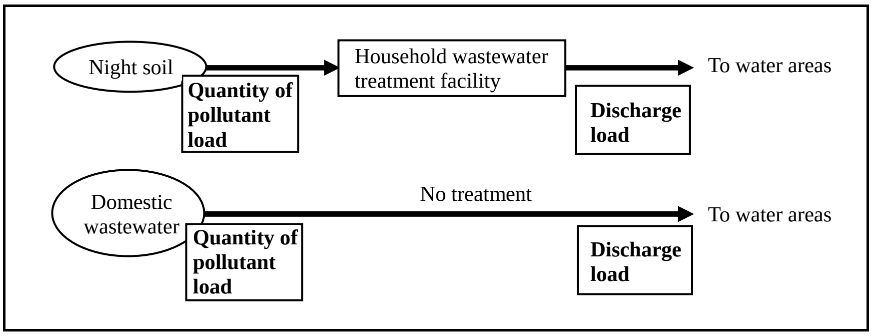
Table B.2 (Reference) Commonly used basic units for discharge load in Japan when domestic effluent is treated at combined household wastewater treatment facilities (g/person/day)

		COD (Mn)	Total nitrogen	Total phosphorus
Quantity of pollutant load	Night soil	10.1	9.0	0.77
	Domestic effluent other than night soil (called Domestic wastewater)	19.2	2.8	0.4
	Total	29.3	11.8	1.18
Extraction ratio		80%	25%	35%
Discharge load	Total	5.86	8.85	0.77

Meanwhile, a combined household wastewater treatment facility for advanced treatment which can remove nitrogen and phosphorus at a high rate has been recently developed, and its diffusion is promoted. When using such a combined household wastewater treatment facility for advanced treatment, the extraction rate should be established at higher values depending on the performance.

c) Treatment at a household wastewater treatment facility: Among various Johkasous, the one that treats only night soil is called a household wastewater treatment facility. This method discharges domestic wastewater without treatment other than night soil.

In Japan, installation of Johkasous has been promoted to facilitate the shift from dip-up lavatories to flush toilets as a part of a project for improving agricultural life, and household wastewater treatment facilities were mainly installed under the project. Since household wastewater treatment facilities can neither treat domestic wastewater other than night soil nor eliminate the COD, nitrogen and phosphorus contents in night soil at a high rate, construction of this type of facilities is prohibited at present. Many have shifted to using sewage systems and combined household wastewater treatment facilities.



○ Use the measured data on the effluent from household wastewater treatment facilities.

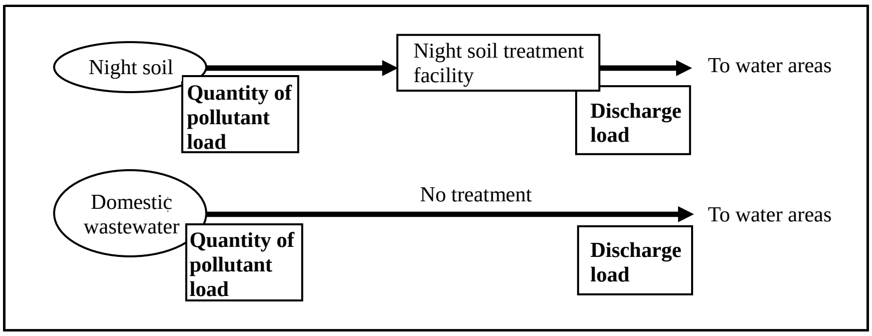
○ If no effluent data is available, calculate it by the ratio method. In that case, calculate the quantity of pollutant load, and for night soil, which is treated at Johkasous, multiply the load by the extraction rate; for domestic wastewater, which is not treated. The quantity of the pollutant load should be used as the discharge load.

○ The typical extraction rates used in Japan are COD = 50%, total nitrogen = 7%, and total phosphorus = 15%.

Table B.3 (Reference) Commonly used basic units for discharge load contained in domestic effluent in Japan when night soil is treated at household wastewater treatment facility (g/person/day)

		COD (Mn)	Total nitrogen	Total phosphorus
Night soil	Quantity of pollutant load	10.1	9.0	0.77
	Extraction ratio	50%	7%	15%
	Discharge load	5.05	8.37	0.65
Domestic effluent other than night soil		19.2	2.8	0.41
Total		24.25	11.17	1.06

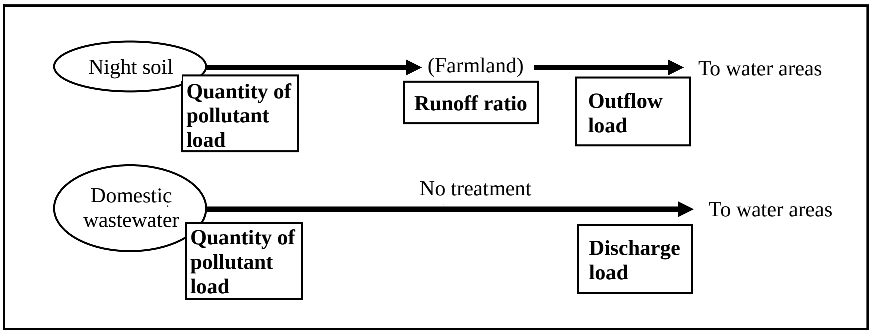
d) Dip-up toilets: Night soil is dipped up from dip-up toilets and transported by vacuum cars to night soil treatment facilities, where it is treated in a centralized manner. This method has been adopted in Japan since old times, but use of this method has been declining. In this method, domestic wastewater is discharged without treatment.



○ For night soil, this method uses the measured data on the effluent from night soil treatment facilities. For domestic wastewater, the quantity of pollutant load is calculated as the discharge load.

e) If both night soil and domestic wastewater are discharged without treatment (this is not the case in Japan), the quantity of pollutant load is calculated as the discharge load.

Alternatively, if night soil is returned to farmlands, to prevent it from flowing directly into water areas, the runoff ratio should be established taking into account the purification effect of farmlands, and the outflow load in rivers should be calculated.



If the sludge of sewage plants or Johkasous are left without treatment, these might be a source. The generated amount and the treatment method of sludge should be assessed.

The current status of sludge treatment in Japan is summarized in Reference Material 5.

iii) Livestock source

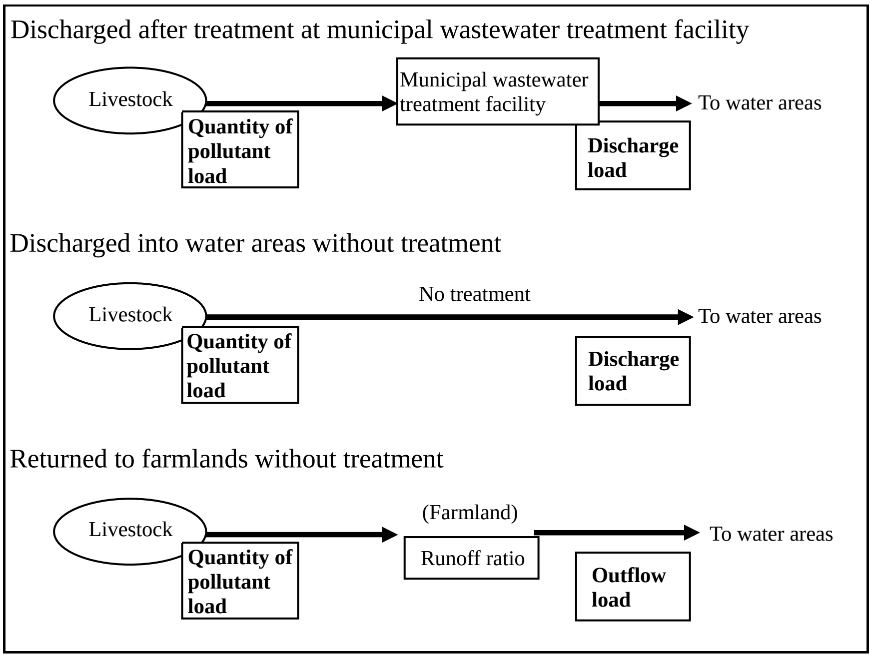
The value of discharge load from livestock barns (calculate the effluent × concentration (of the discharge load from livestock barns) = discharge load) should be obtained.

In cases where the livestock are kept in the small farmyard, or where no data is available on the discharge load even if they are kept on a large scale, the ratio method should be used for the calculation.

First, the basic unit for the quantity of pollutant load per livestock head should be established. Since the basic unit differs depending on the difference in the feeding systems and feedstuff, if a basic unit has not yet been established, it is desirable to specify a basic unit by taking actual measurement, but other basic units used in Japan or other countries may be of reference. The basic units used in Japan are as follows:

Table B.4 (Reference) Commonly used basic units for the quantity of pollutant load from livestock in Japan (g/animal/day)

	COD (Mn)	Total nitrogen	Total phosphorus
Cow	530	280	50
Hog	130	40	25
Horse	530	170	40



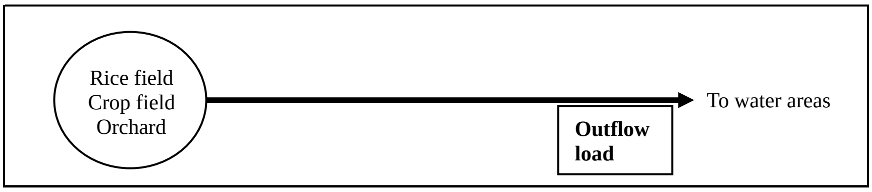
○ If the effluent is discharged after treatment at municipal wastewater treatment facility, when calculating the discharge load using the ratio method, first the quantity of the pollutant load from the livestock heads should be calculated. The extraction rate for the treatment method of the treatment facility should be established, and the discharge load should be calculated.

○ If the effluent is discharged into water areas without treatment, the quantity of pollutant load is the discharge load.

○ If the effluent is returned to farmlands without treatment, or if the livestock are kept in the farmyard and the manure does not flow directly into any water area, the runoff ratio needs to be established. In establishing the runoff ratio, consideration should be given to the amount to be returned as fertilizer, and the ease for the manure to flow into water areas based on the positional relationship between the livestock barns and the water areas.

iv) Plane source load from farmlands

The value of the load discharged from farmlands should be obtained.



This load is calculated using the basic unit per square measure of farmland. For the basic unit, the requirement is to establish this value by actually measuring the load because the basic unit differs depending on the situation of each country and region, such as the amount of fertilizer applied.

The typical basic units used in Japan are as follows. The basic unit for Japanese farmlands is used for calculating the discharge load by the discharge load ratio method.

Table B.5 (Reference) Commonly used basic units for the discharge load from farmlands in Japan (kg/ha/year)

	COD (Mn)	Total nitrogen	Total phosphorus
Rice field	6.4	28	0.37
Crop field	3.7	28	0.37
Orchard	3.7	28	0.37

v) Plane source load from built-up areas

The value of the pollutant discharge load that flows in from built-up areas and roads should be obtained.

This is calculated by using the basic unit per square measure. The basic unit must be established by taking actual measurements because the basic unit differs depending on the situation of a specific country and region. The basic unit for Japanese built-up areas is used as the basic unit for calculating the discharge load by the discharge load ratio method.

Table B.6 (Reference) Commonly used basic units for the discharge load from built-up areas in Japan (kg/ha/year)

COD (Mn)	Total nitrogen	Total phosphorus
3.7	6.9	0.18

When calculating the basic unit for plane source load, the following points need to be considered.

- If wastes are left piled up as they are without collection or treatment, they become a pollution source.
- If eateries and laundry shops are excluded from the calculation of industrial pollutant discharge load, the pollutant discharge load from these pollution sources also need to be considered.

vi) Plane source load from forest

The value of the pollutant discharge load which flows from forest and grassland should be obtained.

The value is calculated using the basic unit per square measure. The basic unit must be established by actually measuring the load because the basic unit differs depending on the situation of the country and region concerned.

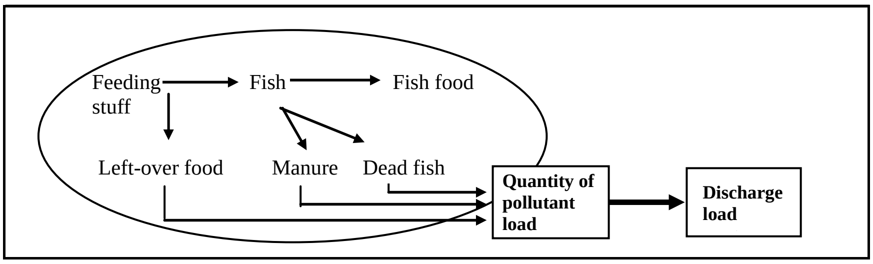
The typical basic units used in Japan are as follows. The basic unit for a Japanese forest is used for calculating the discharge load by the discharge load ratio method.

Table B.7 (Reference) Commonly used basic units for the discharge load from forests in Japan (kg/ha/year)

COD (Mn)	Total nitrogen	Total phosphorus
0.91	6.9	0.18

vii) Aquaculture source

In aquaculture, the amount of left-over food, night soil, and dead fish are the main sources of pollutant load.



The basic unit is calculated by using the basic unit generated per aquaculture production. The basic unit must establish this value by actually measuring the load because the load differs depending on the type of aquacultured fish, aquaculture method, and the temperature of the aquaculture water area.

Table B.8 (Reference) An example of basic units for the quantity of pollutant load per carp aquaculture production of 1,000 kg (kg/year)

COD (Mn)	Total nitrogen	Total phosphorus
144.9	57.2	13.1

In this way, discharge load can be calculated for each source. By aggregating these values, the total discharge load can be calculated.

If many rivers flow into the target water area, aggregation should be done for each river.

By such aggregation, the total discharge load can be captured. Additionally, as the pollutant discharge load for each source can be captured by such aggregation, it is possible to identify the sources that have a significant influence on the target water area. By this means, quantitative information can be provided for exploring the focal points of countermeasures when considering the improvement of the aquatic environment.

The methods for establishing the basic units used for the plane source load from farmlands, built-up areas and forests are summarized in section (2) below.

(2) Methods for establishing the basic unit for calculating the discharge load from plane sources (farmlands, forests, built-up areas)

When calculating the discharge load from farmlands, forests and built-up areas, the calculation is generally conducted using the basic unit. Therefore, the basic unit needs to be decided. In Japan, a host of calculations was conducted based on actual measurement during the first phase of initiating the TPLCS, which was 20 to 30 years ago. Since different measurement points may often give numerical values with a range of more than tenfold, there will be difficulties in establishing the basic units in a consistent manner. However, in implementing the TPLCS, the basic units are indispensable for understanding the pollutant discharge load in watershed areas, and it is necessary to establish them as much as possible to the values adequate for expressing the actuality.

The basic units used in the Japanese TPLCS have a background in which they have been decided using standard values that were established based on a multitude of measurements, accumulated verifications on the consistency with the measured values of the pollutant discharge load in the rivers or sea areas, and accumulated discussions among officials from the prefectural government or other organizations. The basic units are commonly used in Japan as the most authoritative standard units.

The methods for establishing the basic unit will be described below in reference to the guidelines used in Japan.

i) Basic concept

The ratio method includes the discharge load ratio method (a method to find the discharge load from the results of surveys on the target watershed area) and the generated load ratio method (a method to find the quantity of pollutant load from the mass balance). The discharge load ratio method needs only the measurement of discharge load, but the generated load ratio method needs the collection of a wide range of information including various statistical materials and drawings, because the generated load ratio finds the quantity of pollutant load from the mass balance. Consequently, the discharge load ratio method will be primarily explained below.

The discharge load ratio method is based on the field survey (on the water quality/volume) at the points where pollutants flow from the borders of the pollution source or watershed area field into the public waters (sewage drain), and the direct measurement of the discharge load. It is comparatively easy to survey by this method. However, as this method may sometimes entail overestimation due to duplicate measurements of the load from upstream and underestimation due to the inability to measure the load penetrating into the underground, use of this method requires care and attention.

ii) Survey for the calculation of the basic unit

a. Survey method

To obtain the basic unit for the discharge load, it is necessary to capture the discharge load from plane sources by conducting surveys on the flow volume and the water volume at the end of rivers or sewage drains to calculate the annual load, and by subtracting the point source load of the catchment from the annual load.

When conducting the surveys, the following points should be taken into account:

- Surveys should be conducted on the load throughout the year during normal and flood times.
- Information on both the input (inflow/input amount of powder dust/applied fertilizer) and output (status of road surface cleaning, crop yields) should be collected in watershed areas to

confirm the adequacy of the survey points and survey times.

- When conducting surveys for measuring the plane source load of built-up areas, a method that allows for a correct understanding of the first flush runoff during time of floods should be selected, and the inflow load during normal times should be surveyed.
- When conducting surveys on the plane source load from farmlands, the peak flow should be correctly captured during flood times. The properties of each field, such as crop situation, crop types, geology (nature of the soil), terrain, and runoff characteristics, need to be adequately considered.
- When conducting surveys on the plane source load from a forest, it should be confirmed that there is no discharge load from other land categories if the forest is located on a flatland.

b. Establishing the survey points

Surveys be conducted at multiple points over the target watershed area, which should cover as wide a range as possible to enhance the representativeness and to improve the precision. It is necessary to correctly understand the land use and the boundaries of the target watershed area so that the loads from other land categories will not be measured concurrently.

c. Survey times and frequency

As the discharge of plane source load is influenced by rainfall characteristics, seasonal variation, and social and economic activities, the survey frequency should be 4 to 12 times/year (once per each season or once per each month). Surveys should be conducted each season so that any seasonal variation in the load can be captured. Especially for farmlands, the survey time and survey frequency should be considered based on the farming schedule (rice field soil puddling time, rice planting time, fertilizer application time, irrigation method, and winter flooding).

For the discharge load from plane sources, rainfall is a highly needed consideration. Therefore, from the past record of rainfall in the target watershed area, the rainfall characteristics (total amount of rainfall, rainfall intensity, rainfall duration, and no-rainfall period) need to be organized beforehand, and the rainfall scale needs to be established. As the runoff characteristics of the plane source load can be assumed to be different between the beginning and the end of rainfall, each rainfall event needs to be surveyed as a whole at a frequency of every hour to capture the variation of the load.

Reference Material 3: Overview of Japan's Total Pollutant Load Control Standards and examples of the method for establishing the standard values

(1) Overview of Japan's Total Pollutant Load Control Standard

In Japan, the Total Pollutant Load Control Standard has been formulated to regulate discharge load, and the overview of Japan's Total Pollutant Load Control Standard will be described below.

The Total Pollutant Load Control Standard has been set as a permissible limit of pollutant discharge load contained in effluents per day for each business establishment, as shown in Table C.1.

Table C.1 Calculation formula for obtaining the Total Pollutant Load Control Standard in Japan

$$L \text{ (Total Pollutant Load Control Standard)} = C \times Q \times 10^{-3}$$

L: Pollutant discharge load permitted to be discharged (unit: kg/day)
C: Concentration values separately set for COD, nitrogen and phosphorus (unit: mg/l)
Q: Quantity of specified effluent (unit: m^3/day)

* Specified effluent means the water used for business or other human activities at the specified business establishments, excluding water for cooling, decompression, where pollutant load does not increase.

In Japan, the Total Pollutant Load Control Standard addresses specified target business categories, which include factories with effluent amount of not less than $50m^3$/day, business establishments, large livestock barns and sewage plants located in the area where the TPLCS is applied.

The quantity of specified effluent is the value declared by factories and business establishments. (In Japan, operators must notify officials about the volume and quality of effluent and wastewater treatment method when constructing a new production facility or expanding an existing one. If the effluent increases due to the expansion of facilities, another notification is required.)

Effluent concentration standards are now provided for 215 business categories in consideration of the effluent properties of each business category for the purpose of establishing fair effluent concentration values (called C-value).

For newly constructed or expanded business establishments, on the premise of adopting the most advanced environmental technology at each time, strict C-values are applied. For example, the C-values for COD are established for three period divisions in accordance with the time of construction and expansion of production facilities in Japan, and the calculation formula for the Total Pollutant Load Control Standard is as follows:

$$L = (Co \cdot Qo + Ci \cdot Qi + Cj \cdot Qj) \times 10^{-3}$$

$(Co \cdot Qo$	$Ci \cdot Qi$	$Cj \cdot Qj)$
Applicable to the water volume before July 1, 1980.	Applicable to the water volume which increased between July 1, 1980 and June 30, 1991.	Applicable to the water volume which increased after July 1, 1991.

Regarding the determination of the C-value, the Prefectural Governor establishes the value in consideration of the reduction amount required to attain the discharge load assigned to each prefecture within the range for each business category. The upper and lower limits of the range are determined by the Minister of the Environment.

When implementing effluent control, it is important to ensure compliance with the standards by establishing them at a level that can be met by making efforts. Therefore, the requirement is to explore effluent standards based on the surveys on the past drainage record and wastewater treatment status rather than immediately establishing ideal effluent standards. In addition, as manufacturing systems and manufacturing technologies of factories have regional characteristics, these characteristics need to be considered and it should also be considered that in some cases it is not necessarily appropriate to apply the effluent standards of other countries and regions without any adjustment.

(2) Method for determining the standard value (C-value)

Here is shown one example of determining the C-value when using the Total Pollutant Load Control Standard described above for regulating pollutant discharge load contained in effluents. This is a method for determining the value on the basis of field surveys on the actual status of factories and business establishment, and can be applied widely because this method is based on a concept of urging those factories and business establishments whose effluents have a high concentration of pollutant load to implement intensive improvement measures.

First, factories should be ranked in order from the lowest to the highest concentration of pollutants for each business category.

Factories discharging effluents with low concentration of pollutants have advanced production technologies and wastewater treatment facilities, while factories discharging effluents with high concentration of pollutants have backward production technologies and wastewater treatment facilities. If the C-value has been established, the factories and business establishments discharging effluents that contain a higher concentration of pollutants than the C-value have to take countermeasures to reduce the concentration to the level that meets the C-value. As the Total Pollutant Load Control Standard is calculated by multiplying the C-value by the effluent amount, and lowering the concentration by dilution leads to the increase of effluent amount, this is meaningless. Consequently, factories and business establishments have to take measures that will lead to the reduction of discharge load, such as installation or upgrading of effluent treatment facilities and safe operation.

In that case, the reduced amount is calculated as a summation of products of multiplying the effluent amount of factories and business establishments that discharge effluents with a higher concentration of pollutants than the C-value by the difference between the effluent concentration and the C-value. The C-value should be established at the value that allows this amount to be equal to the reduction objective amount.

Figure C.1 below explains this concept.

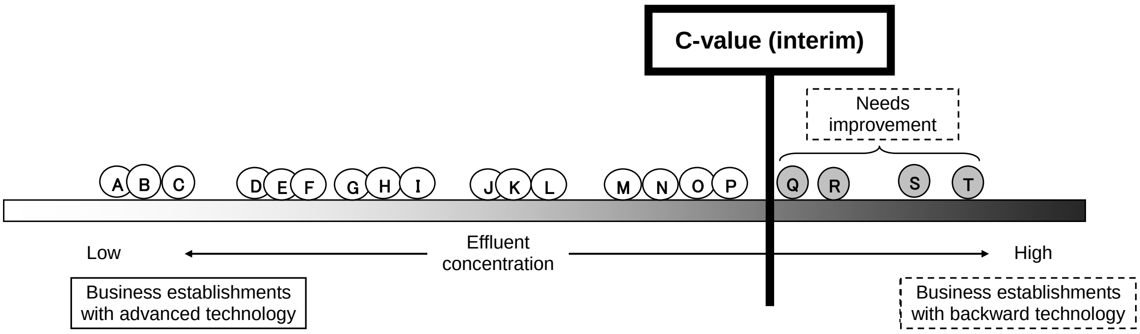


Figure C.1 A conceptual diagram of determining the Total Pollutant Load Control Standard

If a provisional C-value were determined as shown in Figure C.1, four business establishments, Q, R, S and T, would need improvement.

If the effluent amount of the business establishment Q is denoted by Q and the effluent concentration by q, the pollutant discharge load reduced by the business establishment Q meeting the C-value is Q × (q - C-value).

Similarly, if the effluent amounts are denoted by uppercase letters and the effluent concentrations by lowercase letters for the business establishments R, S and T, the summation Y of the pollutant discharge loads to be reduced by these four business establishments is expressed by the following formula:

$$Y = Q \times (q - \text{C-value}) + R \times (r - \text{C-value}) + S \times (s - \text{C-value}) + T \times (t - \text{C-value})$$

The value of Y obtained from the above equation is the reduction amount of pollutant load which corresponds to the provisional C-value. If the value of Y is equal to the reduction objective amount of pollutant load at each time when compared with each other, the provisional C-value should be established as the actual C-value. If the value of Y is different from the reduction objective amount, another provisional value should be established for the C-value.

In contrast, when determining the C-value, it is necessary to make arrangements so that the value can be met by the concerned businesses. One condition for that purpose is to establish the C-value so that the value is not beyond the technological standard attainable at the present time. As shown in

Figure C.1, business establishment A has the lowest concentration of pollutant load in effluents, and it may be possible to regard A as the highest standard technology currently available. Establishing a C-value lower than the one for the business establishment A would be impracticable in terms of technological feasibility. In this case, whether the technology of business establishment A can be applied widely to other business establishments should be a topic for discussion.

In addition, it is necessary to review the C-value on the basis of the confirmed status of water quality of the water area and discharged pollutant discharge loads as needed during the task of reviewing and updating the total pollutant load control plan. At that time, it is also important to revise the C-value into stricter ones in consideration of the progress of wastewater treatment technology and its diffusion status.

Reference Material 4: Measurement method for the water quality of water areas in Japan

This material describes the overview of the fundamental method to be employed in applying the Environmental Quality Standards for Water Pollution to each type of water area and in conducting water quality examinations for establishing additional effluent standards.

i) Frequency of water quality measurement

Measurement should be conducted at least once per month. The water samples should be collected approximately four times each day of taking measurements.

For important locations, the water should be collected approximately once each month or 4 times each year for BOD, COD, nitrogen, phosphorus at a frequency of every 2 hours, totaling 13 times each day.

ii) Survey time

Table D.1 Selection of the time for measuring the water quality of river, lake/pond and sea area

River	Lake/pond	Sea area
• Include the periods of time when the flow volume is low and when the water is utilized. • Select a day when good weather is likely to continue and the water quality is comparatively stable before water sampling.	• As the water quality differs significantly between the stagnation and circulation periods, include both periods. • Select a day when good weather is likely to continue and the water quality is comparatively stable before water sampling.	• Include the period of time when the water quality has harmful effects on water utilization. • If a survey on some inflow river is planned, it is desirable to match the survey time to it. • In principle, select a day at the spring tide when wind and rainfall do not have a large influence.

iii) Selection of water sampling points

Table D.2 Selection of the sampling points for measuring the water quality of river, lake/pond and sea area

River	Lake/pond	Sea area
• A point of water utilization	• Center of the lake/pond	• Select points where the

• A point where main contaminated water fully mixes with fresh water after flowing into the river, or a point before it flows into the river • A point where a branch line fully mixes with the main stream after flowing into it, and a point before the branch line flows into the main stream. • A diversion point of flowing water • Other major points	• A point of water utilization • A point where main contaminated water fully mixes with fresh water after flowing into the lake/pond • A point where a river fully mixes with the other after flowing into it, and a point before flowing into it. • A point where the lake/pond water flushes out • Other required points	contaminated condition of the water area can be comprehensively captured, considering the terrain of the water area, tidal current, water utilization, location of major pollution sources and the status of inflow current of the river. • The standard distance between water sampling points should be in the range of 500m to 1km.

iv) Water sampling method

Table D.3 Water sampling methods for measuring the water quality of river, lake/pond and sea area

River	Lake/pond	Sea area
• Water sampling time should contain the time when the water quality becomes worst, considering the time of human activity, operating hours of factories and business establishments, and the reaching time of pollutants. • In principle, the sampling depth should be specified at approximately 20% of the depth from the surface.	• Water sampling time should contain the time when the water quality becomes worst, considering the time of human activities, operating hours of factories and business establishments, and the reaching time of pollutants. • Water sampling should be done from the surface layer during circulation periods. During stagnation periods, sampling should be done for each different depth, which is to be specified at every 5 to 10m.	• Water sampling time should contain the period of low tides in the daytime. • In principle, water sampling should be done in the surface layer (0.5m below surface) and the middle layer (2m below surface). If the total depth is within 5m, sampling should be done only in the surface layer, and if the total depth is more than 10m, collect the water samples from the bottom layer (10m below surface) as needed.

v) Tasks that should be conducted along with water sampling

Table D.4 Tasks that should be conducted along with water sampling from river, lake/pond or sea area

River	Lake/pond	Sea area
• Record the water sampling date, water surface breadth, distance between the sampling point and the bank, water depth, flow volume, flow direction, rainfall condition, terrain of the sampling point, water utilization, and major pollution sources. • Measure or observe the water temperature, ambient temperature, hue, turbidity, odor, and biota on the spot.		• Record the water sampling date, location of water sampling points, water depth, times and tide level of ebb tide and high tide, flow direction, rainfall condition, terrain of the sampling point, wind direction/velocity (or wind power), water utilization at the sampling point, and major pollution sources. • Measure or observe the water temperature, ambient temperature, hue, turbidity, odor, transparency, salinity on the spot.

vi) Measuring methods of the flow volume of rivers

As flow volume data is indispensable to the calculation of pollutant discharge load along with water quality data, this should be measured when water sampling is conducted. Flow volume should be a sum total of the value obtained by dividing the cross-section of the river as needed and multiplying the cross-section obtained from surveying by the flow velocity of the respective cross section.

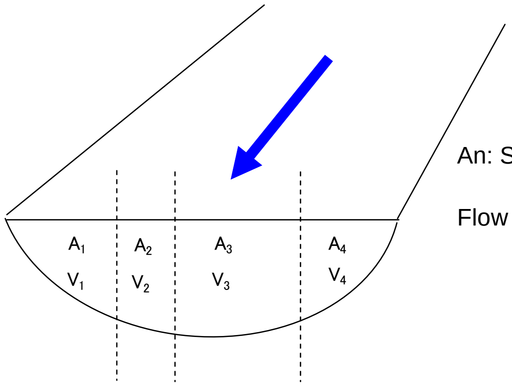
In principle, average flow velocity should be measured in accordance with the following methods:

If the water depth is not less than 1m・・・2-point method using current meter (average the data at 20% and 80% of the depth from the surface)

If the water depth is less than 1m・・・1-point method using current meter (current velocity at 60% of the water depth)

However, if the water depth is extremely shallow and it is impossible to take measurements with a current meter, other measurement methods may be employed, such as a floating wood measurement.

As an example of the above, Figure D.1 shows the case in which the cross-section of the river is divided into four parts.



An: Sectional area, Vn: Average current velocity

Flow volume = $A_1 \times V_1 + A_2 \times V_2 + A_3 \times V_3 + A_4 \times V_4$

Figure D.1 Schematic diagram of the cross-section of a river in the measurement of flow volume

Reference Material 5: Current status of sludge treatment in sewage plants in Japan

Sludge is generated when wastewater is treated by a biological treatment process such as an activated sludge process. In an activated sludge process, 50 to 70% of the BOD is consumed as energy, and 30% to 50% is used for bacteria cell growth, which means a large amount of pollutants are concentrated in sludge. Therefore, if sludge is left as it is and allowed to release the pollutants into the water area again, the effect of wastewater treatment will be considerably diminished. Wastewater treatment is completed when sludge is appropriately stored and treated.

(1) Status of sludge treatment in Japan

Sludge is mostly water, and much effort is required in treating sludge. In the past, sludge was landfilled, but for reasons that it has been increasingly difficult to secure landfill space year after year, effective use of sludge has been promoted.

In Japan, the ratio (by weight) of effectively used sludge to the total amount was only 16% in 1990, but the ratio increased each year. As of 2004 approximately 67% of the total amount of sludge was effectively used. In addition, even if sludge is landfilled, it is not allowed to be landfilled as it is, but is required to be reduced in quantity by incineration. As of 2004, 87% of landfilled sludge was reduced in quantity by incineration or molten slag treatment.

The treatment process of sludge begins by eliminating the water content to approximately 85% by concentration and dehydration. Then, depending on the treatment method, the sludge will go through the drying, incineration, carbonization, molten slag, composting or other process. In Japan, even small sized sewage plants usually install sludge concentration or dehydration equipment.

Concentration of sludge is conducted by gravity concentration, which requires fewer mechanical appliances or no centrifugal concentration. Dehydration of sludge is conducted using screw press dehydrators, centrifugal dehydrators or belt press filters. Because much energy is required to evaporate the water content when drying or burning sludge, it is important to eliminate as much water content as possible in the preliminary stage. Additionally, appropriate water content is also required in the composting process to ferment the sludge, and dehydration treatment is effective for that purpose.

Recycling methods of sludge include the following:

i) Use of green farm

- Utilize sludge as an organic fertilizer by composting.
- Return sludge to land as incinerated ash and dehydrated sludge/dried sludge, and use it as fertilizer, soil conditioner or artificial soil.

ii) Use as construction materials

・ Use the incinerated ash as cement material.
・ Make the sludge into molten slag and use it for bricks and sub-base material.
・ Use the sludge for lightweight aggregate, soil conditioner, permeable block, or concrete aggregate.

iii) Use for energy

・ Use the digestion gas of sludge as energy source or for in-house power generation.

Table E.1 shows the status of sludge treatment and its recycling in Japan.

Table E.1 Status of sludge treatment and its recycling (FY2006)

(Based on the dried weight of sludge: tons)

	Landfill	Recycling				In-house storage	Total
		Use of green farm	Construction materials		Fuels		
			Cement	Other than cement			
Liquid sludge	0	4	0	0	0	4	4 0.0%
Dehydrated sludge	36,816	28,072	92,923	2,618	3,161	150	163,764 7.3%
Composting	592	240,585	0	3,318	0	1	244,496 10.9%
Dried sludge	3,944	31,516	1,992	6	16,083	3	55,160 2.4%
Carbonated sludge	21	1,733	898	181	0	102	2,934 0.1%
Incinerated ash	518,538	26,879	698,896	302,153	4	10,023	1,556,493 69.6%
Molted slag	237	3,308	6,371	200,722	776	733	212,146 9.5%
Total	560,146 25.1%	332,093 14.9%	802,697 35.9%	508,998 22.8%	20,025 0.9%	11,040 0.5%	2,234,998 100.0%

Among the several effective usages of sludge, its use as construction material is the most common, and accounts for approximately 80% of the total use of recycled sludge. The construction material made from sludge is mainly incinerated ash and molten slag. The sludge effectively used for green farms accounts for 14% of overall sludge use, 75% of which is for fertilizer.

Alternatively, in terms of the treatment method of sludge, incineration accounts for the largest share at 71.7%, followed by molten slag and composting, each accounting for approximately 10%.

In considering the method for treating sludge, it is important to select the most appropriate sludge treatment method for each region, based on the demand for sludge-recycled products, treatment cost, resources, waste disposal and policies for establishing a sound material-cycle society.

As sludge contains 85% of water even in its dehydrated state, incinerating sludge requires significant energy and cost. From that perspective, composting is an advantageous usage of sludge. The production amount of sludge fertilizer in Japan was 1.37 million tons in fiscal year 2007 including industrial sludge use. Use of sludge was equivalent to an average of 300kg per one hectare of agricultural land.

(2) An example of composting sewage sludge

The overview of the composting process of sewage sludge is as follows.

Sludge is dehydrated at sewage plants or night soil treatment facilities, and delivered to factories as dehydrated sludge. Then the sludge is mixed with wood chips, adjusted to contain 60 to 70% of water, and piled in fermentation buildings, where it is fermented.

Fermentation buildings have aeration facilities, and air is blown in accordance with the status of the fermentation. Additionally, the piles are turned upside down almost every other week to promote fermentation and prevent uneven fermentation. As the factory shown below has a large production scale, heavy machinery is used for this reversal operation. In this way, composting is completed in approximately two and a half months. The inside of the fermentation building is as shown in Figure E.1.

Figure E.1 Fermentation building

After the composting process has been completed, the sludge is put through a sieve, the main purpose of which is to sort out the wood chips. The sorted-out wood chips have a significant amount of bacteria. The chips are again mixed with compost and then piled up as a raw material for fertilizer. Compost can be produced at a rate of approximately 25 tons per 100 tons of sludge.

The major contents of the compost are as shown in Table E.2.

Table E.2 Major contents of compost

Total nitrogen (%)	1.5 - 1.7
Total phosphorus (%)	4.0 - 5.0
Total potassium (%)	Less than 0.5
Carbon/nitrogen ratio	7.0 - 9.0
pH	6.0 - 7.5

Periodic inspections of the compost are conducted to detect harmful heavy metals and noble metals. The delivered sludge is also verified for its contents under a quality management program when concluding a treatment contract with a sewage plant by requiring the plant to submit declaration forms.

The conditions for such composting plants to succeed are the state of the delivered sludge and the demand for compost.

The delivered sludge is composed of the sludge of sewage plants and night soil treatment facilities, but if raw garbage is mixed in with the sludge, composting faces difficulty. Sewage systems are the facilities for treating domestic effluent. In Japan, discharge standards to sewage apply when the effluents from factories and business establishments are discharged to sewage systems, and these standards regulate the discharge of wastewater containing harmful heavy metals and chemicals into sewage systems. It is important to oversee the quality of sewage sludge in this way.

The demand for compost is also important. Compost is an organic fertilizer, and easily fits in with the soil and is absorbed into crops because it has been fermented. Compost also helps to soften the soil and to make fertile soils without reducing the fertilizer effect. Organic farming and soil management are now under review, and many farmers who have never used compost are likely to use it in the coming years.

The treatment of sewage sludge for successful composting requires a stable supply of sludge with uniform property and quality like the above, and ensuring the demand for compost. For sludge composting plants, it is considered possible to construct such a plant in accordance with the generated amount of compost, as long as the amount of compost is not less than a certain level. Sewage plants constructed in rural areas may choose to install a dehydration device and a composting plant in the treatment facility. When a large-scale factory is to be constructed, it is necessary to estimate the collection range and amount of sewage sludge, and consider the demand for compost around the plant and the scale and location of the facility.

Reference Material 6: Status of the water quality in East Asia

East Asia has seen significant growth in economy and society and is regarded as the growing center of the world. The ASEAN countries have seen a twofold growth in their population in the past 40 years and a continual high rate of economic growth. Along with these growth trends, pollutant discharge loads are increasing. Water resources are running short, and there is a mounting call for effective use of water resources, including prevention of water area pollution, elimination of water utilization problems, and promoting the reuse of industrial water, and for diffusion of water treatment technologies.

Table F.1 shows the per capita GDP of East Asia in 2009. It also shows the data of Japan in 1965 for reference, when the effluent treatment could not catch up with the growth of industry and economy, leading to the degradation of the aquatic environment in many parts of the country. East Asia including Malaysia, Thailand, China and Indonesia is approaching almost the same level that Japan had at that time, and is considered to be in almost the same situation surrounding economic development. As mentioned in section 1.3, Japan saw a serious exacerbation of the aquatic environment in many parts of the country, difficulties in water intake for tap water, and frequent fishery damage, so that it was forced to take urgent measures in this period. East Asian countries are also approaching the stage where they will be forced to take measures.

Table F.1 Per capita GDP of East Asia (Based on USD: 2009)

China	3,734	Indonesia	2,329	Laos	885
Korea	17,074	Philippines	1,747	Myanmar	571
Thailand	3,940	Vietnam	1,068	India	1,032
Malaysia	6,950	Cambodia	768	(Reference) Japan (1965)	3,170

* Japan’s per capita GDP in 1965 is a price-adjusted value.

Among Southeast Asian countries, in 1970 Malaysia, Philippines and Singapore introduced water and ambient air environment-related laws which directly influence human health. In the 1990s Indonesia, Thailand and Vietnam introduced such laws (See Table F.2).

However, efforts toward protecting the aquatic environment have only recently been initiated. Large-scale factories and industrial parks including foreign-affiliated businesses are treating effluents, but only a few small and mid-sized factories are equipped with a wastewater treatment facility. Sewage systems are also under construction, and there are cases where domestic effluents such as factory effluent and night soil are discharged into rivers as they are. Consequently, the need is to promote domestic effluent measures, such as dissemination of early morning wastewater measures and construction of sewage systems.

Table F.2 A list of the enactment years of environment-related laws in East Asia

	China	Indonesia	Malaysia	Philippines	Singapore	Thailand	Vietnam
Basic Environment Law	1973 (1989)	1997	1974 (1998)	1977 (1978)	1999 (2000)	1992	1994 (2005)
Water quality	1984 (2008)	1990 (1995)	1975 (1997)	1975 (2004)	1975 (2001)	1992 (1996)	1993 (1995)
Ambient air	1987 (2000)	1993 (1999)	1978	1977 (1999)	1971 (2002)	1992 (2005)	1993 (1995)
Wastes	1995 (2005)	1988 (2001)	1989 (2005)	1990 (2000)	1987 (2000)	1992	1999
Environment Impact Assessment	1979 (1998)	1993	1987 (1995)	1977		1992	1994 (2006)

* ( ) shows the most recent year of revision as of 2007.

In addition, the input of nitrogen fertilizer has considerably increased along with agricultural development, causing nitrate pollution of water and eutrophication of water areas in some parts.

In the Philippines, Lake Laguna, located to the south of Metropolitan Manila, Luzon Island, is planned to be used as an important drinking water source, but the lake is contaminated with the effluents from the factories around the lake, and protection of the lake's water quality has become a challenge.Thailand also has serious water pollution in the Chaopraya River, which runs through the capital city of Bangkok, 75% of the cause of which is considered to have come from commercial facilities without appropriate effluent treatment equipment. The rest is considered to be domestic effluent. In some localities, pollution of agricultural water due to increasing consumption of chemical fertilizer is raising concerns. In addition, eutrophication is in progress in many of the lakes/ponds and catchments that play an important role as a source of drinking water.

Water pollution is gradually becoming a serious problem in East Asia. The level of water pollution is almost the same situation that Japan had during its high economic growth period. It is also important to make use of Japan's experience and lessons because effective measures are called for now. Since water pollution in East Asia has many sources of pollutants in the industrial and domestic sectors, appropriate measures are required. Eutrophication is occurring in enclosed water areas such as lakes/ponds and long rivers with stagnant water. The application of the TPLCS could be a high priority option.

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